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Vol. 50. No. 1. (New Series. Published Bi-Monthly). February, 1943
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THE
Journal of Obstetrics & Gynaecology
of the British Empire

VOL. 50, No. 1 NEW SERIES FEBRUARY, 1943

A Study of Craniolacunia

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CRANIOLACUNIA is the name recently suggested to replace the term Lückenschädel hitherto used to describe a curious, striking appearance in the bones of the skull in infancy. We support the use of this new name because it describes more accurately the appearances upon which the diagnosis depends, and brings it into line with the approved terminology of similar conditions such as craniostenosis.

The condition is described and discussed here because, in our first patient, we were fortunate in diagnosing it in a foetus *in utero*, which being later born dead gave us rare material for examination; and secondly a review of the literature made it apparent that we could contribute critical opinion on certain observations made and repeated in the past which we believe to be misleading. Thirdly, our interest aroused, we sought for further examples, found one case in which a possible antenatal radiological diagnosis was missed, within a few days had seen 5 more, and within 5 months the number had increased to 11, thus demonstrating that what had appeared to be a condition of extreme rarity in this country, may prove in fact to be relatively commonplace.

Craniolacunia (Lückenschädel, Relief Skull, Lacunar Skull) is characterized by an abnormal development of the bones of the vault of the skull, in which thick bony bars or ridges are formed on the inner surface of both squamous temporal, parietal, and frontal bones, and the squamous occipital. These bars run a variable course from case to case, sometimes diverging and then converging, forming a network so as to enclose between them lake-like areas, where ossification is diminished or absent and where the thickness of the bone is correspondingly reduced. Sometimes the bars are broad and dense, with the lacunae poorly defined or shallow, sometimes (as in hydrocephalic skulls) the lacunae are large, very numerous and relatively deep, the bars being of varying thickness. The outer surface of the bones is smooth, and the lacunar appearance is seen only by radiography *in vivo*, or by radiography, transillumination, and direct inspection

after death. This lacunar appearance may be so marked as to permit of confident radiological diagnosis at the 7th month of foetal life or so slight as to be dubious on good X-ray films taken in early infancy.

Literature

Craniolacunia usually occurs in association with congenital defects such as spina bifida, encephalocele or club feet, and in fact was first observed and recorded by West[1] in 1875, by Kassowitz[2] in 1880, and by Von Recklinghausen[3] in 1886 as a skull defect occurring in cases of spina bifida. Von Recklinghausen considered that a meningeal hydrops was a possible cause of the condition, in that it produced an inincreased intracranial pressure which compressed the cerebral convolutions against the cranial bones and so impaired their normal ossification. He considered that the depressed areas of parchment thickness bone corresponded in position to the gyri, whilst the bony ridges followed the pattern of the sulci and vessels.

Engstler[4] in 1905 described a case of this condition in a living child aged 4 days with spina bifida, and was able to trace 11 other cases in the literature. He regarded the theory of increased pressure with disfavour and suggested that there was an occlusion of the vertebral arteries, which resulted in abnormal ossification of the vault bones. In 1909, Wieland[5] supported the theory of increased pressure, and pointed out how susceptible to pressure effects the cranial bones were, in view of the rapid growth of the brain and the under-development of the lateral portions of the skull arch during foetal life. Kassowitz stated that pressure on the skull during birth was sufficient to cause resorption of bone corresponding in position to the convolutions. In 1921 Hughes[6] described infantile craniotabes, which he considered to be a fresh manifestation of a foetal atrophy of the vault bones; his illustrations suggest that his cases were those of craniolacunia which he attributed to syphilis or rickets. Cohn[7] in 1924 rejected the theory of increased intracranial pressure as a cause of the disease because he had discovered it in otherwise normal children; he considered that the normal process of development and calcification was merely delayed. In 1931, Faust[8] reverted to the pressure theory, stating that the associated meningocele functioned as a tension valve.

The study of craniolacunia was next taken up in America by Kerr[9] in 1933 and by Doub and Danzer[10] in 1934. The latter published 2 cases and collated several interesting facts. They found that a spinal deformity or encephalocele was always present, that rib deformities were common, that the cranial sutures, although not bulging, were usually wide, and that hydrocephalus was a frequent accompaniment. They favoured increased pressure as an aetiological agent. Vogt and Wyatt[11] in 1941, affirmed that the lacunae were not convolutional in disposition and, therefore, that increased pressure was not a causal factor. The defects may be obliterated after a year, especially in hydrocephalic skulls, and moreover, they found the condition, although rare, to occur in the absence of meningocele. Thus in 5,000 patients without meningoceles, it was only present twice; whilst of 120 patients with meningoceles, 52 showed craniolacunia. It was further demonstrated that craniolacunia when associated with meningocele constituted a bad prognostic sign.

It is significant that only one case seems to have been described in this country (Shearer[12]). The condition is almost unrecognized here. For example, in Wakeley and Orley's "Textbook of Neuro-radiology" published in 1939, two cases are reported without mention of Lückenschädel (as the name was at

that time), but both examples illustrated are typical. The first, showing a huge meningomyelocele has obvious lacunae in the vault bones, whilst the second shows them together with craniostenosis, but they are not referred to in the text. Shanks, Kerley and Twining, a three volume modern treatise on Radiology, mentions Lückenschädel and dismisses it very briefly as a form of craniostenosis, making no mention of its association with spina bifida or any other deformity, or of its existence independently from craniostenosis.

Case Records

The first case which attracted our attention was noteworthy in that, for the first time, the diagnosis was made before birth, radiologically. Our investigations were centred on this case, which we therefore report in detail. Subsequent cases are reported more briefly.

Case 1. The mother Mrs. W. H. was a primigravida, aged 23 years, who came from a healthy family. Her mother and two sisters had had several pregnancies, but no stillbirths. Their children had no deformities, none had died at an early age, and none was mentally abnormal. The female relations of her husband gave similar histories. The patient herself was a well-built girl with no evidence of congenital abnormality nor of rickets. She had had scarlet fever at 9 years of age, and an appendicectomy performed at 18 years of age. Her husband had a marked scoliosis but was otherwise healthy. Radiographs of both parents' skulls were taken and both presented normal appearances.

The mother attended the antenatal clinic regularly and appeared to be a normal case until October 9th, 1941, in the 36th week of pregnancy, when it became apparent that she had developed hydramnios. This was not excessive, and the foetus could still be palpated, being found to lie in the right sacro-posterior position. The foetal heart sounds could be heard, and there was no evidence of pre-eclamptic toxaemia.

A radiological examination was made, the presentation was confirmed, and craniolacunia and spina bifida found to be present. Our reading was as follows:

October 9th, 1941. "Single foetus; breech; in R.S.P. position, with extended legs. Gross deformity of the lumbar spine, and abnormality of development of the frontal area of the skull. Probably a case of Lückenschädel with spina bifida. Normal maternal pelvis." (J.B.H.)

A low surgical rupture of the membranes was performed on October 16th, 1941, and 2 days later she gave birth without difficulty to a stillborn female child, which was delivered as a breech with extended legs. The foetal heart sounds were heard during the 1st stage of labour, which was prolonged, but not following full dilatation of the cervix. The placenta was born 5 minutes after the foetus, and appeared to be quite normal; the whole labour lasted 40 hours.

Wassermann tests were performed on the maternal and on the foetal blood and both were negative.

The child was a female of calculated maturity of 37 weeks. Her weight was 4 pounds 14 ounces and its length 17¼ inches. The head was not unduly large, and its circumference measured around the occipito-frontal diameter was 12½ inches. The sagittal, metopic, coronal and lambdoid sutures were still open and measured ¼ inch in width; the posterior fontanelle was still present and the anterior fontanelle measured 1½ inches long by 1 inch wide. Foramina, depressions or ridges could not be felt in the bones of the cranial vault.

The lower dorsal and lumbar spine showed marked abnormality, a large myelocele being present. There appeared to be failure of fusion of the neural arches of the 9th dorsal to the 2nd lumbar vertebrae, the bodies of which formed an angular lordosis. The cord lay exposed in the hollow of the lordosis entirely bereft of superficial covering, with the central canal opening into the upper part of the exposed area.

An incision was made in the sagittal plane of the skull, and the cranial vault with the dura mater attached was freed from the underlying brain. Lacunar depressions were immediately noticed on the inner surface of the cranial bones, and the relation of these to the surface of the brain

was observed. It soon became apparent that there was no relation between the ridges and depressions on the cranial bones, and the sulci and convolutions of the brain. *In no area did the cerebral convolutions fit into the bony depressions.* The meningeal and cerebral vessels similarly bore no relation to the network of bony ridges; the brain in fact was normal, the ventricles were not dilated, and the cortex was not thinned.

The cranial bones were carefully removed from between the pericranium and dura mater, and studied in some detail. The same changes were found to affect the parietals, frontals and the squamous portion of the occipital bone; they were present, although to a lesser degree, in the squamous portions of the temporal bones and the great wings of the sphenoid. Externally these bones were of normal smoothness, but their internal surfaces were marked by a network of bony ridges which enclosed circular and oval areas of very thin bone, measuring ½ to 1 cm. in diameter, while in some of these areas, ossification of the membrane had not occurred, and true foramina were present. The bony configuration thus produced did not resemble the cerebral pattern of gyri and sulci, but was an independent design of contiguous circles and ellipses. This was best shown in the frontal and parietal bones. (Fig. 1.)

The remaining organs of the foetus appeared normal. There was no clubbing of the feet and no congenital heart disease. The endocrine glands, including the suprarenals appeared normally developed. (Observations of C.W.F.B. at post-mortem.)

The radiological features of this case were:

(*a*) Those already described in the report on the foetus *in utero*, i.e. the defect in the cranial bones and the deformity of the spine (Fig. 2).

(*b*) Those of the stillborn foetus which were:

1. The typical defective ossification shown by the dense bony bars and the contrasting lacunar areas, these changes being confined to the frontal and parietal bones, and the squamous portion of the occipital.

2. Absence of recognizable sutures in the cranial vault.

3. Prominence of the frontal region with relative depression of the bridge of the nose. Deep and large orbital fossae. The bones of the base of the skull were apparently normally developed.

The spheno-occipital suture presented normal appearances and the space normally visible at term between the squamous occipital and the ex-occipitals in the lateral view of the skull, was also present and of normal width.

4. Deformity of the spine resulting from extensive and gross failure of normal development of the lower four dorsal and upper two lumbar vertebrae. The cervical spine was normally developed. The spine below the 2nd lumbar vertebra presented a return to normal appearances of the individual vertebrae except that the lumbar spine as a whole was of such dimensions that it resembled a sacrum. There were 12 ribs on the right side. On the left side the 3rd rib and the head of the 8th were defective, while the 9th, 10th, 11th, and 12th were represented by a single deformed unit.

All the long bones, the pelvis, both scapulae and both clavicles exhibited normal appearances for a foetus of this age (Figs. 3a and 3b).

(*c*) The contrasting appearances of these craniolacunar vault bones when radiographed side by side in the dried state, with bones from a normal foetus of the same age (Fig. 4). The striking features on comparing the appearances of these sets of bones are the changes in organized pattern of the bony detail and the difference in the bony outline. In the normal skull the trabecular pattern radiates from a point at or near the centre of the bone finely and evenly in all directions to the periphery, whereas in the craniolacunar bones, particularly the frontals and parietals, this

pattern is almost completely lost. The bone edges in craniolacunia are ragged and irregular in striking contrast to those of the normal skull bones. Superimposed upon the exceedingly fine pattern of trabeculation, the bars and lacunae of craniolacunia are very evident. It also becomes apparent that the squamous temporals share in the craniolacunar changes, although this fact is not demonstrable in the radiograph of the intact foetal skull. It is in the deposition of the bone that the abnormality lies; where bone has been laid down it tends in general to be of normal density.

The vault bones shown in Figs. 1 and 4 from two foetuses of the same age were weighed. These weights are given in the following table.

Bones	Weight of normal	Weight of craniolacunar	Per cent of normal
Frontals	2.25 grm.	1.18 grm.	52.4
Parietals	3.57 ,,	2.21 ,,	61.9
Squamous occipital	2.45 ,,	1.48 ,,	60.4
Total	8.27 grm.	4.87 grm.	58.9 per cent

Case 2. The mother, Mrs. N. S., aged 27 years, was a primigravida who gave birth normally to a female stillborn child at term on November 4th, 1941.

The child had a large meningocele present in the lumbar region associated with talipes of both feet. Radiographs of the skull revealed the presence of craniolacunia with raggedness of the posterior margins of the frontal bones and anterior margins of the parietals, while irregularity of bony density and the lacunar defects were also evident in these bones. The wide sutures were clearly visible, and the bones of the base of the skull and face were normal. The whole of the dorsal spine showed a condition of spina bifida; the upper six pairs of ribs were deformed; there was a sharp kyphosis and scoliosis in the lumbo-dorsal spine, and in the upper lumbar region there was gross developmental defect in the formation of the vertebral bodies. The long bones and pelvis showed no abnormalities of development or structure.

Review of the antenatal radiographs of this stillbirth in the light of our investigation of Case 1 showed that the associated skull defect and spinal deformity were there demonstrable.

Case 3. G. R. was a living male infant, born November 2nd, 1941, as the second of twins. His brother appeared healthy and weighed 5 pounds 7 ounces, whilst he himself had an occipital encephalocele of practically the same size as the head, and weighed 7 pounds 4 ounces. His skull was the smaller of the two, and had a markedly simian appearance, while the bones of the vault, X-rayed 24 hours after birth, showed typical craniolacunia of a mild degree. The bones of the face and of the base of the skull were normal. There was no bulging of the sutures, which were ¼ inch in width, and the anterior fontanelle was slightly larger than that of his twin (Fig. 5). No defects were detected in the remainder of the skeleton.

The skull of the twin brother was normal in size and shape. The bones of the base, the facial bones, the frontals and the squamous occipital were normal in appearance. The lateral radiograph showed a small area of abnormal ossification in the upper parietal region, but no true craniolacunia. No defects were detected in the skeleton radiologically.

Case 4. H. S. was a full term male, born October 31st, 1941, weighing 7 pounds 8 ounces, and exhibiting a sacral myelocele. Radiographs 8 days after birth did not show any deformity of the spine or skeleton, apart from the lumbo-sacral spina bifida. The bones of the vault of the skull

showed mild but definite craniolacunia, with the posterior margins of the parietals extremely irregular, and the coronal and lambdoid sutures very wide but not bulging. The space between the squamous occipital and the ex-occipitals was normal in width and definition.

CASE 5. S. R. was a female born November 11th, 1941, at term with small meningoceles in the mid-dorsal and lumbar areas and with paralysis of the left leg. She was referred for X-ray examination of the spine on November 15th, 1941, abnormality of the skull not having been noted clinically. Fortunately the radiographs included the skull: they revealed well-marked craniolacunia, the facial bones and those of the base of the skull being normal, whilst the bones of the vault showed typical bars and deep lacunae. In contra distinction to the previous cases described, the fontanelles were almost closed and the sutures were detectable only on close examination. The upper six cervical vertebrae were correctly formed, but the 7th cervical vertebra and the whole of the dorsal spine showed gross deformity (scoliosis and kyphosis), the development of the individual vertebrae within these limits being completely chaotic.

Radiographs obtained 5 months later, a few days before death occurred, showed that the contrast between bars and lacunae had distinctly diminished in spite of the enlargement of the head which had taken place, whilst the sutures were enlarged as compared with the original size, there being thus a definite suggestion of concomitant diminution of the craniolacunia, together with the development of a degree of hydrocephalus.

CASE 6. This child, H. H., a living male, was admitted to hospital on December 5th, 1941, having been born at term that day in the district.

It was sent because it showed: (1) Extensive spina bifida, with myelocele. (2) Gross deformity of the dorsal spine. (3) Bilateral talipes equinovarus. (4) Deformity of the penis and of the nose.

It was referred for X-ray examination of the spine only, but the whole child was radiographed. Study of the films revealed: (*a*) Mild craniolacunia with deficient ossification of parietals, normal ossification of the base, and normal sutures and fontanelles. (*b*) Skull of normal size and shape. (*c*) Gross dystrophy of the dorsal spine, with spina bifida in the lumbar and sacral regions.

CASE 7. The mother, Mrs. A. B., was delivered at term (December 24th, 1941) of a stillborn male child, whose skull being markedly hydrocephalic, had required perforation to effect delivery. Examination showed the bones of the vault to be larger than normal, with ragged edges and gross craniolacunia, the lacunae being very poorly ossified with many areas of total bony deficiency (fenestrae). These features are clearly shown in the photograph of the dried vault bones (Fig. 6). There were also spina bifida and a myelocele in the lumbar region of the spine.

Radiographs of this foetus demonstrated typical lacunae in the vault bones of the skull, whilst in the spine and ribs several abnormalities were seen. There were six cervical, 12 thoracic, 6 lumbar and 5 sacral vertebrae; all their bodies were distinct and normally formed, but there was spina bifida from the mid-dorsal region downwards. The 4th right rib was broad, and it bifurcated from its mid point, while the 5th showed a deformity of its head and neck.

X-ray films obtained by the use of Grenz rays (Fig. 7) demonstrate strikingly the extent and degree of faulty ossification of the dried, disarticulated frontal and parietal bones and the squamous occipital. Comparison with Fig. 4 shows the exaggerated form of craniolacunia which may occur in the bones of the hydrocephalic skull.

CASE 8. J. B. was a living female child delivered December 15th, 1941, at term. The sutures of the skull were ¼ inch in width and the fontanelles were large, although there was no suggestion of hydrocephalus. Spinal deformity or other skeletal defect was not apparent. Radio-

logical examination of the skull revealed the appearances in the bones of the vault of a mild form of craniolacunia. The bars were not thick and the lacunae were relatively shallow, but the pattern was quite unmistakable. The spine was normal.

CASE 9. The mother, Mrs. V. S., was a primigravida, aged 22 years, who was referred to one of us (J.B.H.) for radiological investigation on February 4th, 1942, the foetal head having failed to descend into the pelvic inlet.

The radiological report was: "There is a single foetus which shows gross deformity of the spine and is in danger of presenting as a brow or a face. I think there is slight hydrocephalus. In addition the skull bones are not of normal density and I strongly suspect that this foetus will be found to show craniolacunia associated with spinal deformity and either encephalocele, or meningocele or myelocele. I would very much welcome the opportunity of X-raying this foetus after delivery."

At delivery, February 24th, 1942, the hydrocephalic skull was perforated and a female foetus showing complete lumbar spina bifida, was born.

Clinical examination of the skull bones after removal of the brain showed the usual smooth outer surfaces of all the bones of the vault, while on the inner surfaces, the bars and lacunae were clearly to be felt and seen.

Radiographs of this skull demonstrated the typical appearances of craniolacunia without the very marked fenestration which was exhibited in the vault bones of the hydrocephalic foetus in Case 7. The deformity of the lumbar spine corresponded accurately with that revealed in the antenatal radiographs of this foetus, there being well marked kyphosis of the lumbar spine, while both the lumbar region and the sacrum showed spina bifida.

CASE 10. The mother, Mrs. L. W., was a primigravida, aged 30 years, admitted February 23rd, 1942, suffering from eclampsia.

On February 25th, 1942 (i.e. in the 34th week of pregnancy) she was delivered of a male, stillborn hydrocephalic foetus, weighing 4 pounds 15 ounces. There was no other skeletal deformity to be seen clinically.

Radiologically gross hydrocephalus was confirmed with craniolacunia which, although not as marked as in Case 7, was quite typical except that, owing to the gross hydrocephalus, demonstration of the margins of the bones of the vault was not successful until they had been disarticulated and dried. There were found also bilateral cervical rib, deficiency of the 3rd right rib, and defective development of the 1st and 2nd dorsal vertebrae. Neither the lower femoral nor the upper tibial epiphyses were visible.

CASE 11. The mother, Mrs. E. G., aged 25 years, was delivered on March 10th, 1942, normally, at home, of a living female child weighing 8 pounds, which was admitted to hospital because of spina bifida and a discharging lumbar meningocele. By chance the existence of this child in the ward was discovered by one of us and the whole child was examined radiologically. Well-marked craniolacunia was revealed, the bars and lacunae being well developed. The fontanelles were large and all the sutures were wide. The margins of the vault bones were not as irregular as those seen in hydrocephalus, of which there was no suggestion here.

The difficulties of obtaining first-class radiographs of a living infant of this age by means of a mobile ward unit, which was all that was available in this instance, will be appreciated. Nevertheless, the dorsal spine as far as the 11th vertebra appeared to be normally developed. In the lumbar region there was slight but definite kyphosis and scoliosis and there was clearly visible the lumbar meningocele, measuring 5.5 cm. transversely, 5.2 cm. in length and projecting backwards for 2.5 cm.

This mother gave an interesting obstetrical history thus: 6 years ago, spontaneous

miscarriage at 4 months; 4 years ago, delivery of normal living female child by the forceps; 15 months ago, induction at $7\frac{1}{2}$ months of an anencephalic foetus.

Discussion

It is remarkable that this sequence of 11 cases of craniolacunia should have occurred in our hospitals during a period of 5 months, considering that only one case has been reported in this country since 1875; and it has provided us with much material for investigation. In addition to this series, we have found 2 more cases of craniolacunia illustrated in books, yet remaining undetected, and we continue to discover other examples whenever old pregnancy radiographs come up for review. Two requests to neighbouring obstetricians to send their next cases exhibiting spina bifida to us for investigation, resulted in the demonstration of craniolacunia of obvious degree in each case.

We estimate that the condition is appearing at present in 0.8 per cent of all births, having found 5 examples occurring in 600 deliveries at one hospital during the period of our investigations. We thus support Vogt and Wyatt's estimate, which was based on an examination of 6,000 skulls of infants, and which also placed the incidence at 0.8 per cent.

We suggest that radiological examination of the skull should be carried out in addition to radiography of the spine, in all cases of spina bifida and hydrocephalus. Three of our series (Cases 1, 2 and 9) show clearly that antenatal radiological examination does enable the diagnosis to be made before delivery provided that the radiologist is aware of the significance of the abnormalities revealed. It is certain that careful examination of routine pregnancy radiographs and radiological examination of the skulls of children exhibiting spinal defects will demonstrate the comparatively high incidence of craniolacunia.

The theories which have been advanced in the past by various authors to account for craniolacunia can be broadly classified into the three following groups.

Group 1. Theories of inherent developmental defect.
Group 2. Theories of causal disease.
Group 3. Theories of pressure disturbance.

Evidence derived from the study of our series of cases throws considerable new light upon these earlier theories. Thus we are unable to support Engstler's proposition that the developmental defect is due to the diminution of blood supply resulting from occlusion of the vertebral arteries. We can find no evidence that this occurs, and moreover it would not explain the frequently associated spinal defect. Cohn who first reported the existence of craniolacunia in normal infants, maintained that it was merely a manifestation of delayed development in such cases; Vogt and Wyatt also reported two such examples. We agree that it does exist in otherwise normal infants (as in Case 8), but it cannot be an expression of delayed development, because the bars and ridges of a craniolacunar skull in a foetus of 8 months (Case 1) were thicker than the bones of the normal skull at term. It is thus a disorder of development and not a simple underdevelopment.

All observers have stressed the frequent association of craniolacunia with other developmental defects such as talipes and spina bifida which may be either myelocele or meningocele, single or multiple, small or large, and may occur in any region of the spine. Encephalocele is also described. Doub and Danzer alone have recorded the presence of deformed ribs in a single instance. All these types

FIG. 1.

Photograph of the dried vault bones from Case 1, showing well-marked craniolacunia, beside those of a normal foetus of the same age.

FIG. 2.

Radiograph from Case 1, showing clearly the spinal deformity and defective ossification of the bones of the vault which enabled the ante-natal diagnosis of craniolacunia to be made.

FIG. 3a.

Lateral radiograph of the stillborn foetus.

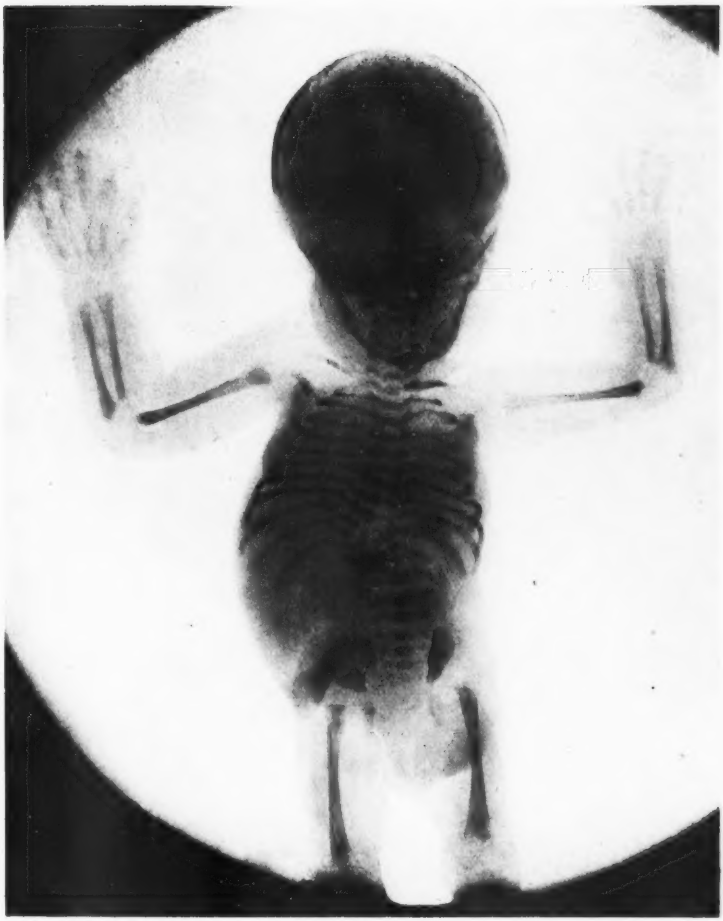

FIG. 3b.

A.P. view of this foetus. Confirming the presence of craniolacunia and the spinal defect.

H.& B.

FIG. 4.

Contrasting radiograph of the dried skull bones seen in Fig. 1, showing the normal structure of the vault bones at 37 weeks as compared with the faulty architecture seen in craniolacunia at the same stage of development.

H.& B.

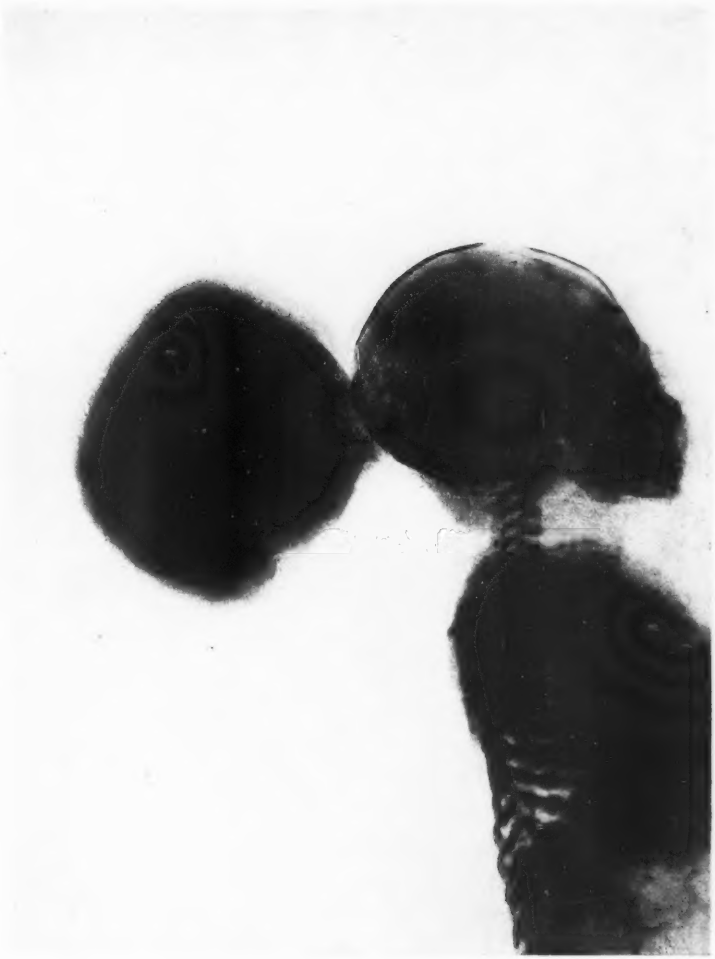

FIG. 5.

Lateral radiograph of Case 3, showing encephalocele and well-marked craniolacunia.

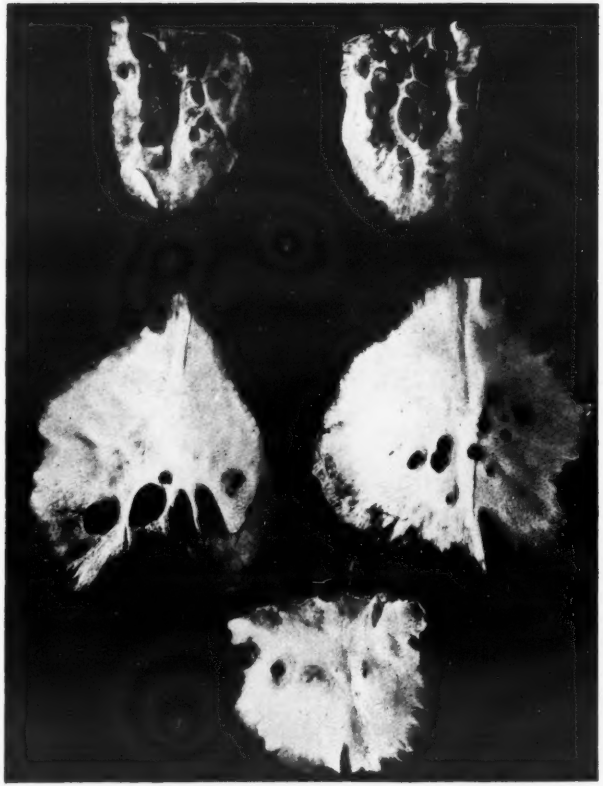

FIG. 6.

Photograph of the dried vault bones from a hydrocephalic skull (Case 7) at term. The frontal bones in particular and the parietal bones to a lesser extent, show the extreme degree of the anomaly which we propose to call craniofenestria.

H.&B.

FIG. 7.

Photograph of the dried vault bones from Case 7 which shows even more strikingly than the photograph (Fig. 6) the extent and degree of developmental deficiency which can appear when craniolacunia and hydrocephalus are associated.

of defect have occurred in our series. Thus myeloceles were present in Cases 1, 4, 6 and 7, and meningoceles in Cases 2, 5 and 11. The spine of Case 10, which clinically did not show any sign of abnormality, was shown radiologically to be defective in the development of the bodies of its 1st and 2nd dorsal vertebrae, which had been formed from two centres of ossification which had failed to fuse centrally. Case 8 alone was free from any spinal defect. Case 3 exhibited a large occipital encephalocele, while the detection of rib deformities in 4 of our cases (1, 2, 7 and 10) has enabled us to confirm Doub and Danzer's original observation. Talipes, frequently reported by early observers, was present in Cases 2 and 6, while two deformities hitherto unrecorded in the literature, namely hypospadias and malformation of the soft tissues of the nose (the nasal bones, maxillae, and others being normal), were seen also in Case 6. Sear[13] has shown that craniolacunia is frequently present in cases of the rare condition craniostenosis. None of our series demonstrates this association and in fact the only example of craniostenosis which we have encountered during this investigation, which was incidentally, a cyclops, was devoid of the lacunar changes. We agree with Vogt and Wyatt that the frequency with which these apparently developmental anomalies are associated with craniolacunia does support the view that they may all result from an inherent developmental defect, which mainly involves the various parts of the enfolding mesoblastic layer of the skull and spine.

Few authors have supported the theory of a disease process being the causative factor. Hughes alone has suggested that rickets and syphilis might be responsible, while some German authors have favoured syphilis. Doub and Danzer, who based their report on the Wassermann test of two mothers, rejected this contention. Obstetrical histories, clinical examinations and blood tests on mother and child have made us do likewise; furthermore radiological examination of the skulls of known syphilitic infants has not once revealed the presence of craniolacunia. We have not found any clinical or radiological evidence of rickets in any of our cases: we have investigated questions of heredity, the age and degree of parity and general health of the mother, and find that none of these has any bearing on the aetiology. In our series there were 5 males (of which 2 were stillborn) and 6 females (of which 3 were stillborn) so that neither the sex of the infant nor foetal mortality is of significance. Pre-eclamptic toxaemia had no relation to the condition, 10 of the pregnancies being free from toxaemia, and one having fully developed eclampsia. Hydramnios is well known to accompany foetal deformities so that its occurrence in our series is not surprising. Thus we have not found any evidence to suggest that disease plays any part in the causation of craniolacunia.

The explanations of the lacunar changes in the vault bones of the skull which have attracted the greatest number of adherents, are those based upon the supposition of abnormal pressure bearing upon the developing skull, either from without or from within. Kassowitz, who advanced the theory of external pressure, considered that it was exerted on the skull during labour and was sufficient to account for the changes observed. Although finding no supporters, this suggestion has never been rejected, because the diagnosis of craniolacunia prior to delivery had never been made. Our series finally disposes of this theory, since the definite antenatal diagnosis was made in Cases 1 and 9, 4 weeks and 3 weeks respectively before the calculated date of delivery.

The theory of increased pressure upon the bones from within, by means of an increased intracranial pressure, was accepted by many authors, from Von Recklinghausen in 1886 to Shearer in 1937, and was based on the pure assumption that the lacunae corresponded to and were produced by the cerebral convolutions, and that they were analogous to the "thumbing" which has been so widely accepted in the past as evidence of internal hydrocephalus. Superficially this explanation appeared to be reasonable, especially as the frequent association of craniolacunia with spina bifida suggested the dual result of internal pressure effects and Faust even suggested that the cerebro-spinal fluid drained away from the brain through the spinal defect and thus allowed the convolutions to exert excessive pressure on the developing skull. The not uncommon finding of hydrocephalus, mentioned by Doub and Danzer, and wide sutures and large fontanelles in cases of craniolacunia appeared to support this view. Not until 1941 was doubt thrown upon this theory, when Vogt and Wyatt questioned the possibility of the developing infantile brain, which is gelatinous in consistence at this age, causing convolutional impressions in the skull bones. Our findings in Case 1 completely disprove this theory, because at postmortem it could be seen that the gyri did not fit into the lacunae; the bony bars were crossed at all angles by the convolutions and the two patterns were entirely dissociated. Furthermore, there was no evidence of increased intracranial pressure having existed, and the ventricles presented normal appearances. Detailed study of the skull bones and their radiographs (Figs. 1, 4, 6 and 7) shows that there is not any constant lacunar pattern in the corresponding bones of different cases, such as one would expect if the lacunae were produced by the convolutions.

The analogy to "thumbing" of the skull we believe to be incorrect. In this condition bony bars of more than normal skull-thickness are never produced, and the depressions never disappear when once formed, whereas the lacunae, as we have observed in Case 5, were becoming less obvious within 5 months of birth. Vogt and Wyatt state that the latter were often obliterated after one year. Moreover it is quite erroneous to regard "thumbing" as evidence of increased intracranial pressure, precisely because it can be shown to be as marked in some normal individuals as in cases of proved raised intracranial pressure: indeed in the latter evidence of "thumbing" may be completely lacking. Increased intracranial pressure cannot be the common cause of wide sutures, large fontanelles and craniolacunia, because although they are often found in association (Cases 1, 2, 3, 4, 8 and 11), craniolacunia does occur when the sutures are small (Cases 5 and 6) and even when they are prematurely closed as in craniostenosis, as Sear has shown. American writers stressed the frequent combination of craniolacunia and hydrocephalus, Doub and Danzer expressing the view that they were usually found to co-exist. In our own series of 11 cases 3 were hydrocephalic (Cases 7, 9 and 10). We consider this to be the only evidence which supports the theory of increased intracranial pressure as a causal factor, but even this we do not accept, because examination of other hydrocephalic skull bones has failed to reveal any evidence of craniolacunia. Thus the theories which account for the occurrence of craniolacunia by alterations of pressure, although ingenious, are not supported by careful postmortem findings, or by recent evidence.

It is strikingly apparent that the craniolacunia occurring in Case 7 is of a more pronounced character than that present in

our other cases. Complete defects of ossification preponderate, with the result that actual perforations covered by membrane are more frequent than lacunae. This is well shown by comparison of Figs. 1 and 4, and 6 and 7. The bony bars which slope gradually into the lacunae pass abruptly into the perforations which are characteristic of Case 7, thereby producing a punched-out appearance. We feel that a separate name should be applied to this exaggerated form of craniolacunia, and we therefore suggest the term craniofenestria. It will be seen from Figs. 6 and 7 that this craniofenestria is most extensive in the frontal bones, less so in the parietals and least of all in the squamous occipital.

We suggest that the inferences we have drawn from the material already at our disposal have been sufficient to eliminate most of the previous theories, which have produced a confusing picture in the literature. So far, we cannot confidently replace them with an alternative. We have been unable to discover any causal disease and an abnormal pressure we consider to be most unlikely. Craniolacunia must, we feel, be due to a developmental defect in which two processes are frequently associated, namely the faulty ossification of the primitive membranous vault which surrounds the early brain, and the faulty chondrification of the vertebral bow of the primitive membranous spinal column which surrounds the early spinal cord. Why should this defective formation occur? It may be due to an inherent defect of a chromosomal nature in which unhealthy mesodermal tissue is produced. In this case one might expect to discover evidence of its transmission from parents to offspring. Spina bifida is not a defect which can be handed down to the progeny (except in rare cases of successful operation or in spina bifida occulta), but craniolacunia alone might be so transmitted. It is too early to have seen examples of this, and it is doubtful if it does occur, because as far as we can discover, successive children of the same parents are not afflicted with either of these conditions. Like so many anomalies, its cause must at present remain obscure; factors such as calcium or phosphorus deficiency, abnormal metabolism, hormonal imbalance or toxic process may quite well play a part, but at present we do not have any exact knowledge. It is evident that there exists a large field for future research towards the elucidation of this problem.

Summary

1. Eleven new cases of craniolacunia are reported.

2. The incidence rate is shown to be vastly greater than hitherto suspected in this country and to equal that recently demonstrated in America.

3. The actuality of antenatal radiological diagnosis is emphasized.

4. Most of the previous theories regarding aetiology are shown to be incorrect, and lines of future research are indicated.

5. The term craniofenestria is suggested for the more severe form of craniolacunia which exhibits areas of totally defective ossification.

Acknowledgments

Our thanks are due to Miss Marsden of the Christie Hospital and Holt Radium Institute, Manchester, for the photographs of specimens, and to Mr. A. V. Gill of Kodak, Ltd., for advice in the preparation of the contrast radiographs of foetal skull bones, while Dr. Malloch, Resident Obstetrical Officer at the Lake Hospital, Ashton-under-Lyne, kindly afforded us facilities for the study of the foetus reported in Case 9.

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Maternal Birth Palsy due to Trauma

BY

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MATERNAL birth palsy due to trauma is a rarely reported complication of labour. The paralysis affects part or parts of the lower limb of the mother; appears early in the puerperium or during labour itself, and is caused by trauma to the nerves traversing the pelvis, more commonly the sacral plexus.

As long ago as 1838, von Basedow[1] described such forms of paralysis. Later it was described in the French literature by Bianchi[2] in 1867, and Lefèbvre[3] in 1876. The most quoted paper on the subject, and the first to give a satisfactory explanation of the origin of the paralysis, is that of Hünermann[4] in 1892.

The number of the reported cases of the condition is small and many textbooks on obstetrics make no reference to the complication. Tillman[5] reviewed the literature; collected and analysed 107 cases, and added 8 of his own.

It is interesting to note that the lesion is known to occur in animals as well as in the human. Craig[6] says, "Paralysis after parturition may be occasionally noted in any of the domesticated animals, but it is most frequent in the cow."

During the last 12 months we have had 3 mothers with traumatic birth palsy at University College Hospital.

CASE 1 (G. 206). Age 33, 5-para. This patient's previous pregnancies had all been uncomplicated. The largest infant had weighed 9 pounds 5 ounces, and was the outcome of her second pregnancy in 1933 The present pregnancy was normal.

She was admitted to hospital in labour at term, at 10 p.m. on April 7th, 1941. Her pains had begun at 5.30 p.m. that afternoon. The foetus was presenting by the vertex, which was above the brim of the pelvis and in the right-occipito-anterior position. The membranes ruptured spontaneously 8½ hours after the onset of labour. Her pains were strong and occurred every 4 to 5 minutes, but in spite of this the 1st stage lasted 23 hours, the 2nd stage commencing at 4.30 in the afternoon of April 8th. After 12 hours of labour a vaginal examination revealed that the cervix was '3 fingers dilated,' the foetal head in the right occipito-anterior position and, behind and to the right of the head, there was a prolapsed arm. During the 2nd stage of labour, with the stronger pains, the patient experienced cramp in the left gluteal region, which was agonizing at times and caused her to scream. She could not lie on her left side for the delivery and was finally delivered in the dorsal position after a 2nd stage lasting just over 2 hours. The infant was a male weighing 9 pounds 10 ounces. The general condition of the infant was good, and, except for the development of oedema in the region of the right elbow joint which gradually subsided, his neonatal period was uncomplicated.

On the first day of the puerperium the mother experienced "pins and needles" in the toes and dorsum of the left foot, up to the ankle. She said that she was unable to feel the nurse washing her foot, that the foot felt dead and she was unable to move it properly. On examination on the 4th day of the puerperium, it was found that the left foot was held in the position of equino-varus and that she could not dorsiflex the foot or toes. There

was some blunting of sensation to pin-prick over the lateral aspect of the left leg and over the dorsum of the left foot. A left sciatica nerve palsy, predominantly affecting the common peroneal nerve, was diagnosed. The leg was supported by sandbags with the foot at a right angle. On the 11th 26 weeks after the delivery, there was no disability.

An X-ray pelvimetry, made after delivery, showed a conjugata vera of 4.1 inches and a transverse diameter of the inlet of 5.1 inches. The brim of this pelvis was slightly platypelloid.

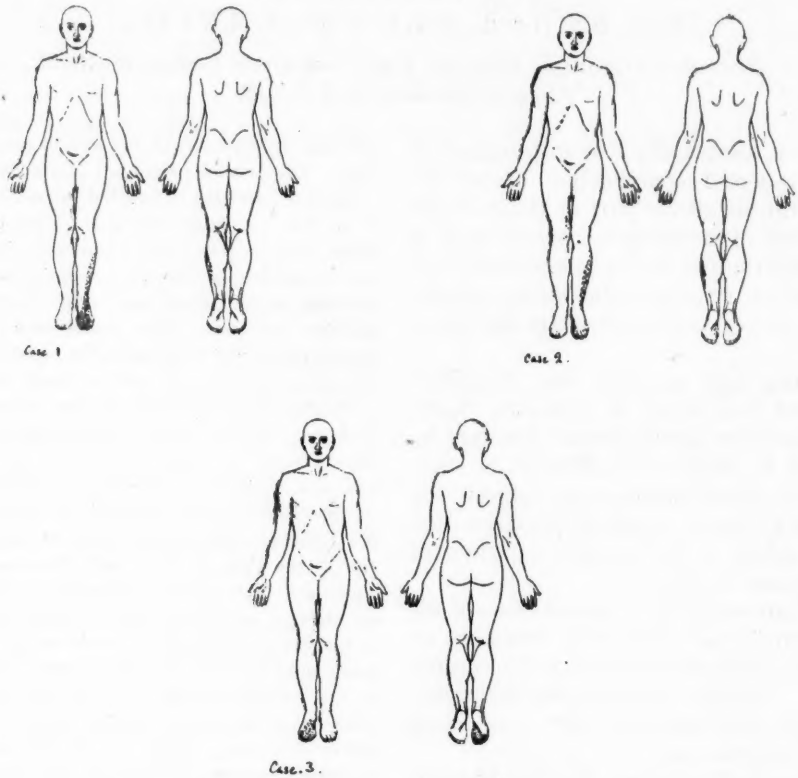

Diagram to show distribution of altered sensation to pin-prick.

day of the puerperium, which was apyrexial, the patient was discharged with the left leg in a plaster-splint. The plaster encased the leg up to the knee and held the foot at right-angles to the leg. The toes were left uncovered on their dorsal aspect, and a walking-iron was attached. The patient was encouraged to walk with the plaster and to attempt to dorsiflex the toes. The plaster was removed after 4 weeks, when it was observed that she could dorsiflex the toes. When last seen,

CASE 2 (G.421). Age 20, 1-para. This patient's previous pregnancy had resulted in an abortion at the 3rd month. The present pregnancy was uncomplicated, except that the foetal head was high and not engaging in the later weeks. The head could be pushed into the pelvis, without any overlap, at the 39th week of pregnancy. An X-ray pelvimetry at the 38th week of pregnancy showed a conjugata vera of 4.8 inches and the widest diameter of the inlet measured 4.9 inches. The

antero-posterior film of the pelvis and lumbar spine revealed: (1) a scoliosis of the lumbar spine to the left; (2) deformity of the pelvis due to some encroachment of the right side of the pelvis on to the pelvic cavity, making the right oblique diameter larger than the left; (3) apparent obliteration of the right sacro-iliac joint due to either a congenital deformity of the joint or an arthrodesis from a previous infective condition; (4) normal appearance of the hip joints. The X-ray suggested a Naegele pelvis.

She was admitted in labour at term on August 16th, 1941, at 7 p.m. She had started labour at 9 o'clock that morning. The foetus was presenting by the vertex, which was above the brim and in the left occipito-anterior position. Her pains were weak at first and occurred every 10 to 20 minutes. The next day (August 17th), the pains were a little stronger, occurring every 10 minutes, and the head was engaging in the brim of the pelvis. On August 18th the head was engaged. The membranes ruptured spontaneously after 85 hours of labour. Following this the patient observed that her left leg felt somewhat useless, and that she could not bear her weight on it. One hundred and four hours after the onset of labour, a rectal examination was made and revealed that the cervix was fully dilated. Throughout the patient had been given sedatives liberally. Her general condition was good and the foetal heart rate was regular. The foetal head was seen, high up in the vagina, 2¾ hours after the onset of the 2nd stage. Further advance of the head was not observed during the next 2 hours, and it was decided to deliver the patient by the forceps. The foetal head was lying almost in the transverse diameter of the pelvis, the occiput being in a plane slightly anterior to the sinciput, and could not be manually rotated. Pelvic application of Milne Murray's axis-traction forceps was found to be impossible as the handles of the forceps could not be properly approximated. A cephalic application was then attempted. The left blade could be applied fairly easily, but it was not possible, owing to the shape of the pelvis, to apply the right blade. Attempted cephalic application of Haig Ferguson's axis-traction forceps was also unsuccessful. Keilland's forceps was then applied with some difficulty, but resistance to advance of the head seemed absolute on applying traction. Craniotomy was therefore decided upon. The skull was perforated and the dead foetus delivered by craniotomy forceps. The mother's condition at the end of the operation was quite good. The foetus was not weighed but appeared to be a good size.

On the 1st day of the puerperium the patient noticed a sensation of numbness over the lateral side of the left leg and beneath the arch of the left foot on the inner side. The left foot felt heavy and dropped easily. She did not complain of these symptoms, however, and was transferred on the 6th day of the puerperium to the base hospital, where she remained until the 13th day. Her puerperium was apyrexial.

She attended the post-natal clinic 3 weeks after delivery and then complained, for the first time, of the numbed sensation in the left leg and of the "flapping foot." On examination it was found that there was weakness of dorsiflexion of the left foot and of abduction of the left thigh. There was some blunting of sensation to pin-prick over the lateral aspect of the left leg, over the dorsum of the big toe, and under the arch of the foot on the medial side. The ankle and knee jerks were normal. Paralysis of the left sciatic nerve, predominantly affecting the common peroneal nerve, was diagnosed. The patient was averse to having a splint and, as there was some power of dorsiflexion of the foot, she was treated by strapping the foot in a position at right-angles to the leg and instructed to wear low-heeled shoes. When this patient was last seen, 22 weeks after delivery, there was no disability to be detected on examination, and she was free from symptoms.

Case 3 (D.719). Age 26, 1-para, a blind, congenital syphilitic patient, whose Wassermann reaction was negative. Her previous pregnancy had resulted in the delivery of a live child weighing 8 pounds 9 ounces. Delivery was somewhat difficult and was effected with the aid of forceps. The present pregnancy was normal, but in view of the obstetric history it was decided to admit this patient at the 39th week and induce labour. The foetal head, at this time, was free above the brim, but could be pushed into the pelvis. X-ray pelvimetry showed a normally-shaped pelvis with a conjugata vera of 4.3 inches and the widest diameter of the brim measured 4.8 inches.

Surgical induction, using a Jaque's bougie, was carried out at 10 a.m. on November 25th, 1941, after an unsuccessful drug induction on November 23rd. The vertex presentation was in the right occipito-posterior position. Twelve hours after the induction labour pains began. During the next 12 hours of labour the frequency of the pains increased but they were not strong, the foetal heart was regular at a rate of 140 to 148 per minute and the patient's general condition was good. The foetal head had not, however, engaged in the pelvic inlet. The bougie was removed from the vagina 15 hours after the onset of labour. The pains at this time were stronger and were occurring every 3 to 5 minutes. Twenty-four hours after the onset of labour, the foetal heart was not heard. The membranes ruptured spontaneously after 40 hours of labour. Three and a half hours later a vaginal examination was made and revealed that the split cervix was almost fully dilated in the transverse diameter owing to the split, but was only 3 fingers dilated in the antero-posterior diameter. The vertex presentation was still in the right occipito-posterior position, and the head was not engaged. As no further advance was made in the delivery during the next 17 hours, and the temperature and pulse-rate had risen to 99.6 and 120 respectively, craniotomy was decided upon. Throughout the labour the patient was given sedatives liberally. Following the perforation of the head a large amount of cerebro-spinal fluid escaped. The dead foetus was extracted with craniotomy forceps and a moderate pull. The foetus had a myelo-meningocele and a small degree of hydrocephalus. It was not weighed but appeared to be of good size.

During the first few days of the puerperium, which was apyrexial throughout, the patient did not make any complaint of untoward symptoms. In view of our previous experience, we asked the patient on the 3rd day whether her legs were quite well. She then told us that she had a feeling of "pins and needles" in the right foot and had noticed that this foot did not feel as strong as the left, but had not thought it worth mentioning.

On examination there was definite, but slight, weakness of the dorsi-flexors of the toes and the ankle of the right foot. Other movements of the leg appeared normal. The ankle and knee jerks were normal. There was some hyperaesthesia to pin-prick over an area which included the medial four toes and the inner aspect of the foot, both on the dorsal and plantar surfaces. A right sciatic nerve palsy, predominantly affecting the common peroneal nerve, was diagnosed. The leg was supported by sand-bags with the foot at a right angle. The next day the sensation of "pins and needles" had disappeared. On the 5th day the sensation was normal but there was still some paresis of the dorsiflexors. On the 8th day of the puerperium she was allowed up and there was seen to be a tendency to drag the right foot. By the 10th day she was walking fairly well but very slight weakness of the dorsiflexors of the foot could be detected on examination. The patient was discharged on the 11th day with instructions to wear low-heel shoes. This patient was seen 6 weeks after delivery and at that time had fully recovered.

Discussion

Aetiology.

Hünermann produced the first satisfactory explanation of the usual localization of the lesion. He attributed the predominant involvement of the common peroneal nerve to its position in the sacral plexus. He considered that the lumbo-sacral cord, as it passes over the ala of the sacrum, is injured by pressure, and that since this cord chiefly forms the main portion of the common peroneal nerve, the injury is manifest by paralysis of the muscles supplied by this nerve.

Thomas[7] elaborated this explanation. He quotes Bardeen of Johns Hopkins University, who concluded, from his investigation of the sacral plexus, that the branches of the 4th and 5th lumbar nerves (lumbo-sacral cord), which go to make up the major part of the common peroneal nerve, are situated on the dorsal aspect of the plexus and therefore lie next to the bone of the sacral ala. Thomas suggests that these dorsal branches of the lumbo-sacral cord receive the chief injury as they lie on the bone and, therefore, the paralysis is chiefly localized to the distribution of the common

peroneal nerve. He adds that the gluteal muscles, which are also supplied by dorsal branches of the lumbo-sacral cord through the superior gluteal nerve, are not infrequently paralysed as well.

An abnormal increase in the intra-pelvic pressure is considered by Kleinberg[8] to be the cause of a bilateral sciatic pressure neuritis and paralysis. He suggests that the fact that the pressure is not of the same intensity on all the nerves accounts for the peculiar and irregular distribution of the motor and sensory symptoms.

Pollock[9] concluded that traumatic birth palsy of the peroneal nerve was due to trauma from the application of the forceps. He adds, however, that the lesion may occasionally occur, in cases of generally contracted pelvis with difficult labour, as a result of pressure by the head of the foetus.

The pressure theory is criticized by Lambrinudi.[10] He states, "Were pressure the mechanism, one would expect the paralysis to occur on the side where the foetal occiput lay. In case 2 (which he reports in the article) the foetal position was left occiput-anterior but the paralysis was on the right side." He also points out that in a certain number of cases, towards the end of pregnancy, the patient complains of pains in the distribution of the sciatic nerve. "Pressure clearly cannot be responsible for the latter, for if the head has already sunk into the pelvis there can be no pressure, and if not there can be no pressure without active and painful contractions of the uterus." He quotes Brooks, who, from his study of pelves of patients who died shortly after labour, concluded that, during the 1st stage of labour, there was a rotation of the sacrum on the ilium in a backward direction, the axis being through the lower half of the auricular facet, and that the excursion in some cases was as much as a $\frac{1}{4}$ inch. Lambrinudi is of the opinion that in a difficult labour this displacement would be even greater and that, as the lumbo-sacral cord is one of the tautest nerves in the body, this displacement would cause traction on the cord. "I would like to suggest, therefore," he says, "that the mechanism of this condition is that of traction on the lumbo-sacral cord, and that the lesion is probably located in the roots of this nerve rather than along its course. This theory would account for both the antepartum sciatic pains and the rare postpartum paralysis, for the loosening of the sacro-iliac joints, which permits the sacrum to rotate, occurs in the latter part of pregnancy."

Four cases of puerperal foot-drop, following forceps delivery, are recorded by Thomson, Harvey and Morgan.[11] They attribute the paralysis "primarily to traction and torsion of the plexus, brought about by forcible rotation and traction of a mass firmly impacted in the bony pelvis."

Paralysis of branches of the sacral plexus may be caused by pelvic infection. Lloyd[12] quotes Hervieux, who, in 1870, reported a case of puerperal paralysis due to pelvic inflammation. Lloyd was of the opinion that, in the majority of cases of puerperal paralysis, septic infection was the cause. More recently, Lindén[13] has reported a case of septic abortion with peritonitis, in which the patient developed a residual abscess and paralysis in the left leg localized to the common peroneal nerve. As the pelvic swelling subsided the paralysis improved. He writes, "I should not think it likely, however, that the paralysis was due to pure pressure effect. I should think it more likely that the inflammatory process has directly affected the nerve."

Trauma to the birth canal during labour predisposes the uterus and pelvic tissues to infection and so indirectly may produce a pelvic inflammation that can cause paraly-

sis. A paralysis caused in this way might, therefore, be included under the heading of traumatic birth palsy. Such cases, however, are to be distinguished from those directly due to trauma by the presence of pelvic inflammation and the onset of the paralysis later in the puerperium.

The lumbo-sacral cord is derived from the anterior rami of the 4th and 5th lumbar nerves. It appears at the medial margin of the psoas major muscle and passes downwards and laterally over the pelvic brim anterior to the sacro-iliac joint. The dorsal part of the nerve is, therefore, in direct contact with the lateral part of the sacral ala as the nerve enters the true pelvis. Anterior to the nerve in this situation are the internal iliac vessels.

When the relation between the pelvis and the foetal head is such as to cause the head, or part of it, to lie over the lateral part of the ala of the sacrum, then there is no reason to believe that any pressure exerted by the foetal head would not deflect the internal iliac vessels laterally and directly press on the lumbo-sacral cord. The only structures then separating the foetal head from the nerve are the uterine wall, the peritoneum, extra-peritoneal fat and fascia. Such structures may possibly produce a cushioning effect for the anterior aspect of the nerve and this would tend to cause the brunt of the pressure to fall on the dorsal aspect of the nerve trunk, the fibres of which supply the common peroneal and gluteal nerves. With regard to the relation mentioned above, Tillman states, "The pelvis is so constructed that the posterior ilium is long, and its curve blends with the sacrum which curves backwards. The dimensions may be either generally contracted or there may be disproportion." Our experience, derived from these patients and from dissection of the cadaver, lends support to this view. It suggests that the part of the foetal head occupying the posterior segment of the inlet of the pelvis may compress the lumbo-sacral cord in cases in which there is true disproportion or when, from some cause, the foetal head is deflected to one or other side of the pelvis. In such cases, the nerve is exposed to pressure provided that the part of the pelvic brim formed by the ala of the sacrum and the posterior half of the ilium has a gentle curve, concave anteriorly, and the promontory of the sacrum is not unduly prominent.

When one pole of the foetal head is in relation to the lumbo-sacral cord on one ala of the sacrum, it is extremely improbable that any other part of the head will have any direct relation to the other lumbo-sacral cord. The lesion will, therefore, be essentially a unilateral one except in certain circumstances to be mentioned later.

The pressure exerted by the head on the nerve is likely to occur at such time when the uterus is attempting to push the head into the pelvis, that is engaging, and when the head is actually engaged, for, as Lindén points out, "if the small fontanelle is forced far down into the pelvis, the anterior part of the head becomes suspended at the inlet of the pelvis and exercises a continual pressure on the nerve trunks which increases at every pain." The pressure is likely to be greatest when the head is tightly fixed and the uterine contractions are strongest. This will usually be when the 2nd stage of labour is being approached or has actually arrived. When the head is freely mobile above the brim of the pelvis, there is then no directing bony channel to keep the head in continuous contact with the nerve trunk. This provides an explanation for the time of onset of pain and other symptoms in the leg being during, and usually during the latter part of, labour.

Compression of a nerve produces interruption of its conductivity, which is usually

temporary and the severity of which varies directly with the force and the duration of the pressure. In general, the longer the duration of this compression, the less the force needed to produce a certain degree of interruption, and *vice versa*. During a delivery by the forceps, any pressure that may occur on the lumbo-sacral cord by the forceps themselves, would most probably take place during the actual periods when traction is made. The duration of such direct pressure by the forceps would be comparatively short. It is, therefore, improbable that the forceps directly can cause trauma to the nerve trunk so as to produce a severe palsy without a great deal of force being used with consequent injury to the maternal birth canal and other pelvic tissues. In our third patient, the nerve injury was considered to have occurred during the extraction of the foetal head by the craniotomy forceps. A moderately strong pull of short duration was needed to extract the incompletely collapsed head, the occiput of which was thought to have compressed the nerve trunk. This patient's palsy was of a very mild degree.

When traumatic paralysis follows delivery by the forceps, the injury to the nerves probably arises more commonly from pressure exerted by the foetal head, which is already active before the instrumentation and which is itself increased by the force exerted by the obstetrician through the forceps, when there has been little change in the obstetrical position of the head. Many of the reported cases mention the fact that the patients, who were delivered by the forceps, experienced pain in the leg during labour. Since the pain occurred before the application of the forceps, the primary pressure must have been from the foetal head and already active.

Bilateral traumatic paralysis, when it occurs, is probably to be explained, as Lindén suggests, by the repeated application of the forceps in difficult labour when the position of the head is altered between the applications so as to affect first one side and then the other, or possibly in some cases by the foetal head affecting one side and the blade of the forceps, lying in the opposite diameter (with good cephalic application) affecting the other.

It is possible that the movement of the pelvis on the sacrum may cause a little traction on the lumbo-sacral cord and possibly contribute to a compression of the nerve as it passes over the sacral ala. If traction were the mechanism, as Lambrinudi suggests, then there is no valid reason why the lesion should not be bilateral in all cases, for any movement of the pelvis on the sacrum is likely to be equal or almost equal to the two sacro-iliac joints. In our second patient the right sacro-iliac joint was obliterated. There is the possibility that a small amount of movement at the left sacro-iliac joint, which appears normal in the X-ray, might have occurred, but this must have been of very small extent with the stabilizing effect of the right arthrodesed joint. Lloyd drew attention to the fact that pressure on the sacral plexus can result from uterine and ovarian tumours in the non-pregnant patient and cause pain and paresis in the distribution of the plexus. He quotes a case of foot-drop and numbness in the leg caused by a large growth situated behind the uterus.

Sciatic pain in the later weeks of pregnancy would also be expected to be bilateral if movement of the pelvis on the sacrum were the cause. In any event, whether traction or pressure on the nerve trunk were the cause, such cause would reasonably be expected to be even more active during labour. Patients with sciatic pain in the later weeks of pregnancy would, therefore, be candidates for traumatic birth palsy. This has not been confirmed

by our experience and suggests that other factors are responsible for the pain in the majority of patients.

Clinical Picture

During labour, which is usually prolonged and is often terminated by operative measures, the mother commonly experiences pain in the leg. This may be accompanied by spasmodic contractions of the leg muscles and severe cramp. The painful symptoms may be masked by analgesics and sedatives as Tillman has pointed out. Agonising cramp was experienced by the mother in the first case reported above, and prevented her from lying on her left side for her delivery.

The paresis or paralysis, depending on the degree of nerve damage, is present from the commencement of the puerperium and may be in evidence during labour itself. The 2nd patient was aware of a feeling of weakness of the leg during labour and it is possible that the liberal administration of sedatives masked any sensation of pain that may have been present.

Paraesthesia in the form of a dead feeling, or of pins and needles, is experienced early in the puerperium and often before the loss of motor power is appreciated by the patient. Hyperaesthesia, hypoaesthesia or complete sensory loss may be detected according to the severity of the nerve injury.

The nerves of the sacral plexus are those most commonly affected, and, of these, the common peroneal nerve suffers chiefly so that foot-drop is the common finding. The gluteal nerves are also frequently involved producing weakness of the gluteal muscles (Thomas, Stander[14]). Evidence of some injury to the tibial portion of the sciatic nerve may be found as well as the above (Lindén, Tillman). Pollock mentions that paralysis of the femoral nerve has followed delivery of primigravidae on a number of occasions.

In the 3 patients reported here, the common peroneal nerve was predominantly affected. The gluteal nerves were also involved in the second patient. All 3 patients experienced paraesthesia; in 2 there was hypoaesthesia and in the third hyperaesthesia, chiefly in the distribution of the common peroneal nerve.

The deep tendon reflexes of the ankle and knee joints may be altered depending on the degree of sensori-motor disturbance and its distribution. The reflexes were unaltered in 2 of the 3 patients tested. There is no note of the reflexes of the third patient (Case 1).

The lesion is unilateral in the vast majority of the reported cases, and was so in the 3 cases described here, but bilateral lesions have been recorded on rare occasions. Thomas was the first to report a bilateral lesion.

There can be no doubt that these cases of traumatic birth palsy, when slight, may pass unnoticed. In our second case, the patient did not consider that the symptoms were worth mentioning until she found them persisting after discharge from hospital. The lesion in our third patient would undoubtedly have been missed altogether had it not been for our previous experience. Mild degrees of palsy may be seen and attributed to a functional cause. Salmond[15] described 2 cases of puerperal paralysis which were considered to be of functional origin. Her second patient complained of severe pain in, and a feeling of weakness of, the left leg during labour. Movements of the leg were, however, observed during the labour. The patient had a long labour with an occipito-posterior position of the head. Manual rotation of the head was performed and a stillborn foetus delivered with the aid of the forceps. Numbness of the left leg was

experienced during the puerperium. She was allowed up on the 10th day of the puerperium, and it was found that she dragged the left leg behind her when she walked. Nothing abnormal was detected on examination of the nervous system at this time. She was treated for 10 days with massage and diathermy and was then discharged well. It is tempting to suggest, from the description of this case, that there was a mild degree of trauma to the sacral plexus during labour.

The possibility of a traumatic birth palsy occurring in the mother should be borne in mind in cases of 'trial labour' and notably in those patients who, during labour, complain of severe pain in one or other leg. Especially is this so if, in addition to the severe pain, there is evidence of spasmodic contractions of the muscles or paresis of the leg.

Traumatic paralysis in the distribution of the common peroneal nerve may occur during delivery from injury to the nerve as it winds round the neck of the fibula by external pressure. Such cases have been recorded by Morgan and Thomson.[16] Traumatic paralysis produced in this way is not, however, peculiar to obstetrics, but its occurrence is worthy of note.

Treatment

Prevention of traumatic birth palsy occurring in the mother is extremely difficult. It is impossible to predict that a patient will acquire the lesion until she develops the warning symptoms of pain and cramps or paraesis in the leg during labour, but the possibility of its occurrence in a trial labour should be remembered. When the warning symptoms appear in a patient during labour, the danger of instrumentation should be borne in mind and delivery by Caesarean section considered if the child is normal and alive. Tillman suggests that " the multipara who presents a previous history of difficult delivery, forceps delivery, stillbirth, recovery from nerve injury should have a Caesarean section." Such treatment will be prophylactic, not only for the birth palsy, but also for the occurrence of a dead baby.

The essentials of treatment of the established palsy are:

(1) Careful splinting of the limb to prevent the occurrence of deformity and to hold the joints in such a position as to relax the affected muscles without, however, overlengthening the unaffected muscles. The splint should interfere as little as possible with the normal use of the unaffected muscles.

(2) To preserve the tone and nutrition of the muscles of the limb by encouraging voluntary, active movements of the limb. Such movements are more effective than massage and electrical stimulation, and are limited only so far as to prevent stretching the paralyzed muscles.

(3) To prevent stiffness of the immobilized joints by a daily period of passive joint movement being carried out.

Prognosis

Tillman writes " These patients will all recover to some degree but many will remain paralyzed." But nerves supplying muscles of coarse and unskilled movements like the common peroneal and gluteal nerves tend to recover from injury more readily than those supplying muscles of fine movements such as the tibial nerve. Further, compression of a nerve usually produces a temporary, incomplete lesion of that nerve, with recovery of sensation preceding the return of motor power. These facts suggest that the milder cases of maternal birth palsy where the peroneal part of the sciatic nerve is affected should recover with proper treatment, and that, in the majority of such cases, the persistence of the disa-

bility is probably due to the overstretching of the paralysed muscles from the lack of early recognition and treatment of the lesion.

Of the patients reported here, the lesion of the first was moderately severe, in the second it was mild and in the third very mild. All three patients have completely recovered from their disability.

SUMMARY

(1) Three cases of traumatic birth palsy in the mother are described.

(2) A brief review of the various suggested mechanisms by which the lesion is produced is given and the aetiology of the condition discussed. The lumbo-sacral cord (the anterior rami of the 4th and 5th lumbar nerves) is compressed, as it lies on the ala of the sacrum, by the foetal head when the relation between the pelvis and the foetal head is such as to cause the head, or part of it, to lie over the lateral part of the sacral ala; instruments by direct injury to the nerve may be responsible for the lesion in some cases.

(3) The clinical picture is described. Attention is drawn to the warning symptoms of severe pain and cramps or paresis in the leg during labour. In such patients the danger of instrumentation is stressed and it is suggested that delivery by Caesarean section should be considered if the child is normal and alive. Especially is this so if the patient is having a trial labour.

(4) The treatment of the established condition and the prognosis are briefly outlined. Early recognition and treatment of the lesion is an important factor in the prognosis.

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The Lessons and Virtues of Salpingography

An Improved Technique.

BY

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DURING the last 17 years 2,000 cases of sterility in private and hospital practice have been investigated by Hystero-salpingography. As would be expected in such a large series not only has every known type of abnormal pathology been met with, but more important, often times one has been able "to search out the secrets of nature by way of experiment" as William Harvey commanded us.

The object of this communication is, however, not so much to demonstrate statistical findings, for these closely follow those of Samuel Meaker and have already been published, but rather to point out the lessons which can be learned and thereby popularize the art of salpingography, an art which hitherto has not earned in the profession the attention it deserves.

Undoubtedly there are pitfalls in the performance of salpingograms, and it may be these have deterred the busy or the timid from adventuring upon this new and scientific approach to the study of the complex problem of sterility; but apart from petty deterrents which are easily mastered, it is perhaps not yet sufficiently appreciated that the therapeutic results of hystero-salpingography are trebly and even quadruply better than those of insufflation—a matter of considerable importance in these days of falling birth-rates.

In order to prove this, Dr. E. J. Topham sent out a *questionaire* to a large consecutive series of patients who had had salpingograms done by the author in the Sterility Clinic of Hammersmith Hospital. The replies, despite the fact that many letters came back undelivered from blitzed areas, showed that 31 per cent of the patients had conceived and gone to term. A similar follow-up of private cases done by the writer in conjunction with Dr. S. C. Galstaun, Dr. H. W. A. Post, Dr. G. R. M. Cordner and Dr. G. T. Calthrop, showed that 43 per cent had become pregnant.

Such therapeutic results may be due to the heavy poppy oil containing 40 per cent iodine acting bacteriostatically upon the mucous membrane of the uterus and Fallopian tubes, or possibly the lipiodol has a stimulative action upon the ciliary mucous membrane and the white tunic of the ovary, or peradventure it breaks down sticky adhesions and thereby reawakens rhythmic movement of the Fallopian tubes which once again can transmit an ovum from the fimbriae to the isthmus. Whatever the cause, if the oil be injected immediately after cessation of a period, conception frequently occurs within 3 months.

Then again, quite apart from its therapeutic value, one must recognize the superlative importance of salpingography in those cases in which doubt exists as to the ability of a woman to conceive after a septic labour or miscarriage, after criminal abortion, fulminant appendicitis, extra uterine

gestation and the like. Such problems frequently present themselves to the general practitioner and gynaecologist and may at times present a medico-legal aspect. An expert hystero-salpingogram will give the unbiased truth of what has chanced, and it is upon this evidence that the gynaecologist can give an opinion, and if need be plan the strategy and tactics of any surgical procedure.

Doubtless in the past many mistakes have been made retarding its popularity. Some have used too much oil; others have applied too much pressure; some have injected the oil under an anaesthetic in an upstairs theatre and then cumbersomely conveyed the patient with the apparatus *in situ* downstairs to an X-ray department; others unthinkingly have continued to use an instrument with a lateral hole for the conveyance of the oil with consequent exquisite cervical pain, and immediate spasm of both uterus and tubes, although it must be 12 years since it was pointed out that all pain could be obviated if the only hole was a distal one which allowed easy transit of the warmed viscous oil into the cavity of the uterus and tubes.

To-day the technique is simplicity itself and is only a matter of collaboration between radiologist and surgeon.

The patient who has previously been examined is asked to meet the gynaecologist in the hospital X-ray Department or the consulting room of the radiologist. She is placed upon the X-ray table in the dorsal position with the buttocks raised on a sand bag. One limb of a Barnes speculum being inserted the cervix is grasped by a vulsellum and painted with dettol or iodine. The nozzle of the syringe—whether it be the beautiful French instrument (as illustrated) which is straight and has a rubber cone, this is the one the author uses* or whether it be the curved and steel acorned modification of Everard Williams—now being introduced and held taut against the cervix, the sand bag is removed. A fluoroscopic screen is then placed upon the abdomen and the lights are switched off. The warmed lipiodol or viscous neo hydriol is then injected and watched on the fluorescent screen passing from the uterus to the tubes and gently spilling (after 5 or 6 c.c. as a rule) into the peritoneal cavity. At the right moment, when a satisfactory picture is featured, the X-ray film is taken.

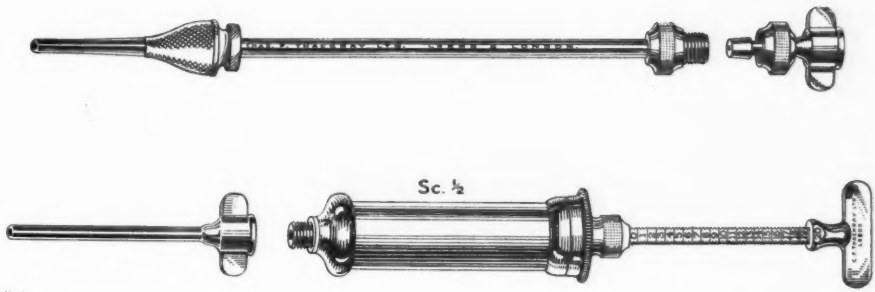
Anaesthetics are never necessary and are indeed better avoided. If the patient is nervous or one suspects from previous examination that she may be spasmophilic, by all means let her have $\frac{3}{4}$ hr. beforehand 1/100 gr. of atropine with, if need be, $\frac{1}{4}$ gr. morphia. In outpatients work where 6 or 7 patients are so examined one after the other neither of these injections is ever needed.

To give an idea of the mistakes committed in former times before the use of the fluoroscopic screen method, it may serve a useful purpose to observe Figs. 1 and 2—the one showing extreme spasm of the uterus and an oil embolus in the uterine veins due to pressure; the other illustrating the mistaken use of 16 c.c. instead of 6 c.c. of lipiodol, even though the patient did later conceive and go to term. Oil embolus though somewhat alarming by reason of pallor and vomiting is only a temporary matter.

Figure 3 still more dramatically demonstrates the advantages of the new technique, for it shows how a careless operator can perforate the uterus. Fortunately this patient did not show any subsequent symptoms. Later she conceived and went to term.

On reviewing a large number of films and follow-ups, one appreciates where and why other mistakes are made. One of the commonest errors is to give a hopeless prognosis when the hysterogram shows that

* Made by Thackray of Leeds, or Down Bros., costing £2 10s.



G.A.

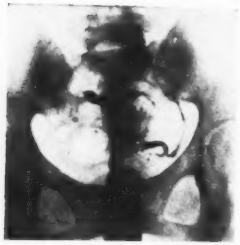


FIG. 1.

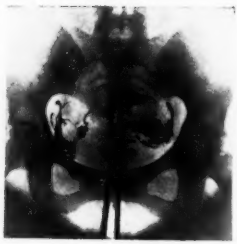


FIG. 2.

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FIG. 10.

FIG. 11.

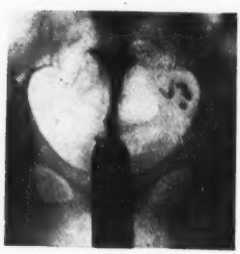

FIG. 12.

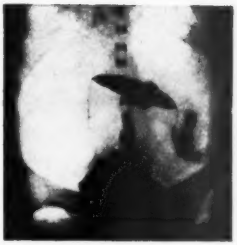

FIG. 13.

FIG. 14.

FIG. 15.

FIG. 16.

FIG. 17.

FIG. 18.

FIG. 19.

FIG. 20.

FIG. 21.

FIG. 22.

FIG. 23.

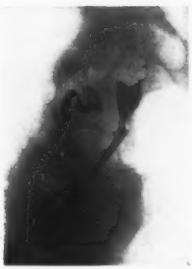

FIG. 24.

FIG. 25.

both cornua are rounded as in Figs. 4 and 5. This happens most frequently when there has been a history of septic labour or criminal abortion. Long surgical experience of such cases, however, has demonstrated that with such a history there is only occlusion of the instertitial part of the tubes and that the distal portions are normally patent. For such, intrauterine tubal implantation can be done—successful results being in proportion to the improvement of the surgeon's technique. Bonney[1] has recorded 18 per cent success. I have had 2 patients out of 7 become pregnant and be delivered by Caesarean section; one other aborted at the 6th month. We must, therefore, admit that when (as the result perhaps of some former folly) a patient is willing to risk failure, that it is worth while performing this operation. Figs. 6 and 7 are illustrations of the Fallopian tubes patent after tubo-uterine implantation by the method described by the author.[2]

Should, however, the history suggest gonorrhoea or acute salpingitis then it will be found that the Fallopian tubes are blocked just beyond the cornua and for their total length, vide Fig. 8. In such, an operation was not worth consideration, but to-day such a statement needs qualification if the infection has been light and the treatment by sulphonamides has been concentrated, for quite a number of these patients are now being seen where the block is only at the fimbrial ends as in Fig. 9.

In such, salpingostomy is worth while, for patency remains and pregnancy occurs. Should, however, one Fallopian tube be blocked or the occluded tubes be not distended at the distal ends, as in Figs. 10 and 11, nothing will succeed. On the other hand if one tube is blocked and the other shows an oleo or hydrosalpinx, salpingostomy is worth performing. Figs. 12 and 13 demonstrate such a case before and after operation (note the Michel clips still on the wound. The patient conceived and had her baby 18 months later at Fulmer Chase Hospital for the Wives of Officers.

The use of amnioplastin will be found a great help in avoiding post-operative adhesions around the newly-opened tubal ostium.

One of the most important lessons to be learned by the gynaecologist is not to give a pessimistic prognosis or to say that the Fallopian tubes are occluded merely because (a) they cannot be seen in the film, or (b) they have a typical ' dog's ear ' appearance at the cornua. This illusion is due to intense spasm of the sphincter muscles of the tubes at the cornua. Figs. 14 and 15 are examples, and both these patients became pregnant within 3 months.

Sometimes when viewing the uterus through a fluoroscopic screen, or in a film, it is seen to be small and hypoplastic and the tubes appear to be long and tortuous—vide Figs. 16 and 17. The inclination is to state that such a patient cannot become pregnant, but when one considers that conception can occur in the isthmial portion of a tube, such an argument based on size alone must be fallacious, for normal conception and nidation depends upon endocrine harmony.

Previous tubercular peritonitis or gangrenous appendicitis not only are a frequent cause of sterility, but also are responsible for mistakes being made in the interpretation of films. In such, oftentimes the uterus is retroverted and fixed by old adhesions and the Fallopian tubes if not occluded have a rosary or beaded appearance due to external kinks forming loculi as in Figs. 18 and 19.

Contrary to expectation operative results are not always as happy as one might hope for in these cases. Fig. 20 shows the end result of an operation done for retroversion and distal occlusion of the tubes subsequent to a gangrenous appendix and pelvic ab-

scess. At first glance the film taken 6 weeks after operation gives the appearance of a perfect result, but if the control picture, Fig. 21, taken 24 hours later is studied, it will be seen that the tubes have again become occluded at the distal ends, and this despite the use of amnioplastin and perfect patency at the time of operation.

Such disappointment, however, should not deter one for the evidence of years shows that more than 30 per cent of salpingostomies are successful.

Every now and then the appearance of the uterus may cause surprise, for a filling defect due to an unsuspected sub-mucous fibroid may be seen which is directly or indirectly the cause of the sterility. Figs. 22 and 23 are examples of this.

Apart from morbid pathology it is necessary to draw final attention to the mistake of solely being guided by an antero posterior picture when the uterus is retroverted or its size is in doubt. Oftentimes a very much better prognosis can be obtained by taking a lateral film which will, as in Figs. 24 and 25 demonstrate not only the size and position of the uterus, but also the relation of the tube and its patency.

Lastly it may be of interest and guidance to state categorically that during the whole period of these investigations using the technique described, never has there been a catastrophe or a case of infection.

I am greatly indebted to Dr. G. S. Galstaun, Dr. H. W. A. Post, Dr. E. J. Topham and Dr. G. T. Calthrop for their untiring patience and help.

Postscript.

It must not be thought that every case of primary sterility is by any means routinely submitted to hystero-salpingography, for if there should be a history of dysmenorrhoea, or examination shows a high degree of flexion or displacement, they are admitted to hospital for dilatation and insufflation with or without shortening of the round ligaments.

In some patients pregnancy has followed simple insufflation in the Outpatient Department or Consulting Room using without any anaesthetic Douay's Tubal Insufflation Instrument with a fine rubber acorned introducer in the cervix up to and above the level of the internal os. An assistant checks the dial reading by listening through the abdomen above the symphysis.

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Simmonds's Disease
Due to Postpartum Necrosis of the Anterior Pituitary

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SIMMONDS's disease is the syndrome which results from destruction of the anterior lobe of the pituitary. The destruction may be produced by various pathological processes. The most common of these is a gross necrosis of the anterior lobe which is caused by severe collapse of a parturient woman at delivery. The collapse is usually but not invariably a result of obstetric haemorrhage. In recent years the disease has gradually become better known clinically, but many cases still pass unrecognized. The chief difficulty arises from the fact that emaciation and premature senility, which are actually rather unusual concomitants, have unfortunately become accepted as the essential and basic characteristics of the disease. The real clinical picture of the disease has thus become somewhat obscured and mistaken diagnoses are made not infrequently. The following case of true Simmonds's disease, though only a single one, is described here for the precise reason that it is typical of the syndrome as it actually occurs, and not because it presents any unusual features. The patient had been under fairly continuous medical observation both at home and in various departments of 6 different hospitals from the onset of the disease, and the diagnosis was finally proved by autopsy. The case was not investigated as completely as it would have been if the nature of the disease had been recognized during life. Nevertheless, the history is sufficiently full to illustrate most of the characteristic features of the syndrome.

Occurrence of the postpartum necrosis of the anterior pituitary.

Before the sequence of events to be described, the patient was a normal healthy woman of cheerful character and active disposition. She married when she was 30 and, at the age of 32, she became pregnant of triplets. The pregnancy continued normally but the delivery was seriously complicated. The first baby presented as a breech and the body was delivered, but the head became locked with another head above the brim. She was admitted in this condition to hospital and, after considerable difficulty, was delivered of the first baby stillborn, and of two live babies. Soon after the delivery she became severely collapsed and was pulseless for several hours. Continuous intravenous and rectal salines were given, and coramine injected. The next day she was slightly improved, but still so ill that the

intravenous saline was continued up to 5 pints and the coramine repeated.

This obstetric history is typical of the condition giving rise to anterior pituitary necrosis. The significant point is that she was severely collapsed after delivery and was pulseless for several hours. The diagnosis of a pituitary necrosis is presumptively justified on this fact alone. The only question which arises is the quantitative one—the extent of the lesion. If the necrosis is so large that the whole anterior lobe is virtually lost, the patient will inevitably develop subsequent symptoms of Simmonds's disease. If it is of medium size, she will escape the full syndrome but will show some indications of impaired pituitary function. If it is only a small necrosis, she will return to normal health. The prognosis at this stage may be assessed from the fact that, in general, the size of the necrosis is proportionate to the severity of the circulatory collapse suffered by the patient at the delivery. It should be noted that total or almost total loss of the anterior pituitary, either by postpartum necrosis or by operative removal as in the experimental animal, is not in itself fatal. The necrosis is only observed pathologically at this early stage if the patient dies of some other condition during the puerperium.

A key to the literature on postpartum necrosis is given by Sheehan,[1] but certain subsequent papers may be noted here. Plaut,[2] who was one of the early workers on the subject 20 years ago, has recently described a typical postpartum necrosis of the anterior pituitary in a woman who died two days after delivery, at which she lost about 1200 c.c. of blood and went into profound shock. Hutchison[3] reports an interesting and unusual case in which a necrosis about 2 days old was found in the anterior pituitary of a woman 10 weeks pregnant. There was severe septic endometritis and pulmonary embolism which had caused the patient to be very collapsed on admission 2 days before death, but the foetus was still *in utero*.

Progress during the puerperium.

About 48 hours after delivery the patient was greatly improved and had a good pulse. No information is available about the condition of the breasts. Next day she developed puerperal septicaemia, with high fever and a leucocytosis of 27,000 per c.mm. The puerperal sepsis continued for several weeks during which she had various complications which are not relevant to the present matter. During this puerperal sepsis she lost a great deal of weight and much head-hair, but these were gradually regained during her prolonged convalescence in hospital. She was not discharged until nearly 5 months after the delivery. During her stay in hospital she had had 13 blood examinations. For the first month her erythrocyte count remained in the region of 3,200,000 per c.mm., and haemoglobin about 37 per cent. After this she was given much iron and there was a gradual and somewhat intermittent improvement so that, at discharge, her erythrocyte count was 4,300,000 per c.mm. and haemoglobin 60 per cent.

The puerperal sepsis was a result of the dystocia and is not to be considered as in any way a cause of the pituitary necrosis. Such sepsis is often quoted in textbooks as an aetiological factor in Simmonds's disease; in fact, as has been shown in previous articles, it does not usually develop until 2 or 3 days after the pituitary necrosis has occurred. The degree of anaemia in the early puerperium was about the same as that which usually accompanies puerperal sepsis (Crawford[4]). In the later puerperium the influence of the pituitary deficiency cannot be excluded as a factor in maintaining the anaemia.

Development of symptoms of Simmonds's disease.

After the patient's discharge from hospital she was not really well. The weight that had been lost during the puerperal septicaemia had been almost completely regained though her face seemed rather thinner. She was remarkably pale; this was noticeable on her lips as well as her cheeks. She felt the cold extremely and, even in summer, spent the whole day crouching over the fire and complaining of the draught on so slight a pretext as a cupboard door being left open. She did not perspire any more. Her mental drive appeared to be lost and she was dull and somewhat reticent, but was still capable of an occasional quiet joking remark. She gave up her own house and went to live with her parents. She "couldn't be bothered" to do things and could not be persuaded to go out for walks or to visit her friends. Her appetite was very poor and there was some flatulence. She complained of a persistent physical weakness. And, a point of great importance, there was permanent absence of menstruation or of menstrual molimina from the time of the delivery.

In the course of the year after delivery she gained a few pounds in weight, and her face filled out to normal, but her other symptoms did not improve. Her medical attendant, 3 years after the delivery, noted that the pallor, the anorexia and the mental hebetude were the most prominent symptoms. Her speech was quite slow and she appeared to have slowness of apprehension in conversation. Her memory was poor, and in conversation she had to stop to think what she wanted to say. She had occasional attacks of slight stupor when she would refuse to answer questions. Her bodily strength was poor and her movements slow. Her hair was thin and very dry. Various medicines including iron and liver extracts were tried without much benefit, though there seemed to be a definite subjective improvement when Radiostoleum was given for a few months.

The clinical picture as far as it goes is quite typical of true Simmonds's disease of this type: a pale woman of normal nutrition but with complete amenorrhoea, who sits all day close to the fire and has obvious slowing-down of her mental and physical processes; the entire condition dating from a delivery at which she was severely collapsed. It is clear at this stage that the pituitary necrosis must have been a large one.

First crisis.

She continued in much the same condition until 4 years after the delivery. Then she had an acute illness of a very significant kind. One day she stayed in bed complaining of general malaise and a feeling of being chilled. She ate nothing at all on this day or the next 2 days, and became gradually rather more ill. Her bowels did not act at all. Late in the evening of the 3rd day she complained of dimness of vision and pains in the eyes. Within an hour or two she began to have a series of convulsions in which there was generalized twitching of the whole body and face. Between the convulsions she seemed confused and her speech was incoherent. She was admitted to hospital 2 hours after the beginning of the convulsions, in a semi-comatose condition with temperature 97°F., pulse-rate 76, and respiration-rate 20. By morning she was rather better but very lethargic, answering questions very slowly but fairly reasonably. She vomited small quantities of greenish fluid at frequent intervals. Her tongue was coated with white fur and her breath foul. There was lateral nystagmus in both eyes and the pupils were dilated. The systolic blood pressure was 90 mm. Hg.

No other abnormality could be found on physical examination but this did not include the genital tract. She appeared to be very anaemic and her complexion was pink and white, but the blood was not examined. She was noted as being well nourished. Her Wassermann reaction was negative. The urine was normal on chemical and bacteriological examination and had a specific gravity of 1042. The next day her temperature rose to 104°F. but, on treatment with M. & B. 693, it fell to normal on the day following. Radiological examination 2 days after admission showed some loss of translucency in the middle of the left lung, suggestive of inflammatory changes; this had disappeared a fortnight later. She was treated with iron, liver extracts and vitamin preparations and was said to be much improved on discharge from hospital 6 weeks after admission.

Crises of this type are quite characteristic of the later stages of Simmonds's disease and are the usual cause of death. The patients are always comatose, and convulsions and spasticity are common accompaniments. When a history can be obtained, it is nearly always found that the patient has eaten nothing for two or three days before the onset of the coma; this is due either to spontaneous anorexia or to vomiting or to some inter-current illness. The exact mechanism of the crisis is not yet quite clear. The blood sugar is extremely low in most of the reported cases, and the symptoms are very similar to those which occur in hypoglycaemic attacks in patients with islet tumours. Certain patients have been treated with intravenous glucose with apparent success. On the other hand, the picture is in some respects similar to an Addisonian crisis, as was suggested by Castleman and Hertz.[5] At present all that can be said is that the crises are probably due to a complex of factors, of which hypoglycaemia and adrenal insufficiency are the two most important. The rational treatment of the crises, according to this theory, should be the intravenous administration of large amounts of glucose and sodium chloride, combined with the administration of adrenal cortex extract.

Second crisis.

There was a phase of temporary improvement after the first crisis; she set up her own house again a few months later and began to cook and do housework. Then she was involved in a motor accident and suffered a fracture of the left tibia about the middle of the shaft. The leg was put up in plaster in hospital and she was discharged a few days afterwards as a walking case. A week later, 9 months after the first attack of unconsciousness, she began to vomit green bile-stained fluid and felt very weak. After a day or two she became comatose and had convulsions. She was admitted to hospital in this condition. She soon regained consciousness and was quite rational, but her cerebration was very slow. There was a trace of albumin in the urine, and she appeared to be very anaemic, but the blood was not examined. Her reflexes were normal, and other abnormality was not found. She was given glucose saline by mouth and the bilious vomiting settled down. Within a week she was taking ordinary diet and seemed cheerful. Iron was prescribed and she was discharged in about 3 weeks.

She returned to live with her mother and attended as an out-patient at a hospital, where the plaster was removed 12 weeks after the fracture. The last X-ray report at 26 weeks after the fracture showed that union was not yet sound. Soon after this she was transferred to another department of the hospital, where a diagnosis of hypothyroidism was made on account of her

clinical condition and appearance. In addition, she was noted to be remarkably pale, so her blood was examined; unfortunately no details about this examination are now available, except that it did not reveal the severe anaemia that had been expected. For the next 4 months she was given an intensive course of thyroid, iron and liver extract but without any recognizable effect, so treatment was discontinued. During this time she gradually became depressed, dull and taciturn. She complained of frequent headaches and her speech became very much slower than before, but her weight remained about the same.

This second crisis was clearly a repetition of the first, and requires no further comment. The gradual development of indications of hypothyroidism in the last year is a common feature of the condition. As a result of this, many patients in the later stages of Simmonds's disease are diagnosed as myxoedema, but the diagnosis has to be reconsidered when it is found that they do not respond to treatment with thyroid. The pallor which was so consistently remarked upon in the present case is a frequent phenomenon, though some patients are described as sallow. Details of the blood examination in this phase are unfortunately lost, but there was only a trivial anaemia at the time of her final illness a few months later. It is possible that the pallor may, to some extent, be caused by narrowing of cutaneous vessels, an antithesis to the Cushing syndrome. A further explanation is suggested by the observation of Fraser and Smith[6] that their Case 10, a Greek, lost his skin tan at the time he developed Simmonds's disease. The view that there may be some direct pituitary control of skin pigmentation also finds support in the fact that these patients never develop any Addisonian pigmentation despite the severe atrophy of the suprarenal cortex.

Third crisis and death.

The patient died as a result of her third crisis 6 years after the delivery. One day, 14 months after the second crisis, she developed a complete loss of appetite and took only one cup of tea. She stayed in bed complaining of great exhaustion and was irritable when urged to eat. During the night she became nauseated, and vomited a little. The next day she was rather dazed but still refused to eat or to go into hospital. Early in the morning of the 3rd day she became delirious and semi-comatose, and within an hour or two she had a convulsion followed by deep coma. She was admitted in this condition to hospital, where she had several generalized clonic convulsions and remained unconscious. There was generalized spasticity most obvious in the legs, where adductor spasm was present, and the tendon reflexes were slightly overactive. The pupils were dilated, but ophthalmoscopic examination did not reveal anything abnormal. Her temperature was 96.4°F. Her pulse-rate was 80 per minute and her blood-pressure 70/50 mm. Hg. Her respirations were only about 10 per minute. She was noted as being of stout build and well nourished and her muscles were normal. Blood count showed red-blood corpuscles 4,800,000 per c.mm.; white-blood corpuscles 6,000 per c.mm.; and haemoglobin 90 per cent. The heart, lungs and abdomen appeared normal, and lumbar puncture gave normal cerebro-spinal fluid. The urine was normal chemically and microscopically. During the day she had some sickness, for which she was given morphine and hyoscine, and glucose drinks. The next morning (i.e. on the 4th day), the coma deepened, her temperature rose to 101°F., her pulse-rate to 90 per minute, and she died.

Postmortem Findings

The skin showed a striking pallor which was very noticeable on the face. There was no axillary hair, a moderate amount of hair over the mons, and normal hair over the labia. The body appeared very well nourished on external examination, and had normal female contours. There was a full normal amount of fat in the subcutaneous tissues, the omentum and round the heart. The *pituitary* was very small, particularly the anterior lobe, which was shrunken and peculiarly translucent. The weight of the whole gland, including a considerable amount of fat and connective tissue from the sides of the lateral sinuses, was 0.42 grm., which is about half the normal. Microscopically the anterior lobe consisted almost entirely of loose fibrillar connective tissue enclosed in a much thickened fibrous capsule. Small groups of apparently healthy anterior lobe cells were present in certain places; (*a*) the largest mass, about 20 acini in horizontal sections, lay at the upper part of the " middle lobe " just beneath the stalk; (*b*) several very small islets, each about 2 or 3 acini in section, were embedded at various points at the sides in the deeper parts of the thickened capsule. These groups of remaining parenchyma were not fibrosed at all, but there was some formation of small colloid cysts in them, particularly in the sub-capsular islets. The posterior lobe was smaller than usual. It showed an obvious decrease in the amount of fibrillary material relative to nuclei, and had two small lymphocyte aggregations near the middle lobe and slight infiltration of the usual wandering basophiles in front. The *adrenals* were very small and thin. Their combined weight, without dissecting off the not inconsiderable amount of fat and connective tissue which adhered to them, was 3.5 grm., as compared with a normal of 10 or 12 grm. The cortex was extremely thin and could scarcely be distinguished from the medulla with the naked eye. The *thyroid* was brown and very small, weighing 8 grm. as compared with a normal of 20 or 30 grm. Microscopically it showed an extreme atrophy like that in myxoedema. About half of the gland consisted of masses of lymphoid cells, often arranged in follicles with very large germinal centres. The remaining alveoli were of two types: small alveoli of about 30μ diameter with flat epithelium and full of deeply eosinophile colloid, and rather smaller alveoli with cubical epithelium and practically no lumen or colloid. There was a relative excess of fibrous tissue throughout. The *ovaries* were like those of an old woman. Microscopically there were a few old corpora albicantia, and two small and atrophic Graafian follicles were found. The *uterus* was very small. Its walls were 6 mm. in thickness, which is about half the normal for a patient of this age. The endometrium was reduced to a single layer of cubical epithelium lying directly on the muscle, with a complete absence of submucous stroma. Occasional very small cysts lined by cubical epithelium were present immediately beneath the surface epithelium, representing the remnants of endometrial glands. The muscle fibres showed a very considerable loss of their cytoplasm only, so that sections of the myometrium showed numerous bundles made up almost entirely of smooth muscle nuclei and separated from neighbouring bundles by an excess of fibrous tissue. The cellularity of the bundles approached to that of a sarcoma. The *kidneys* weighed 64 grm. each, the normal being about 150 grm. They showed atrophy of cortex, medulla and pelvis equally, so that they might have been taken for a child's kidneys. The thickness of the cortex was 3 mm., which is about half the normal.

The glomeruli and tubules were small but normal apart from the presence of an occasional hyalinized tuft. The *heart* weighed 190 grm. as compared with a normal of 260 grm. It showed some atrophy of myocardial fibres with slight excess of lipofuscin and very occasional small foci of lymphocytic infiltration. The *liver* weighed 1150 grm., the normal being about 1500 grm. It was microscopically normal. The *pancreas* was small but did not show any histological abnormality of acini or islets. The *stomach* had numerous masses of lymphoid tissue in the deeper mucosa. The mucosa at the pyloric end appeared otherwise normal, but the mucosa at the cardiac end had the same histological structure as that near the pylorus. The *mammae* were normal on external appearance, but no breast tissue at all could be found in three blocks taken beneath the nipple. The *spleen* was normal macroscopically and microscopically. Haemosiderin was not found in any of the viscera. No abnormality was noted in other organs apart from moderate oedema of the lungs.

These pathological findings are quite characteristic. The original necrosis of the anterior pituitary was a very large one but had spared, as it usually does, a small area just beneath the stalk and a few islets of cells beneath the capsule. After a period of secondary atrophy at its margins, the necrosed area gradually became absorbed, leaving only its condensed fibrous framework. The small remnants of the anterior lobe spared by the necrosis persist at the surface of the shrivelled scar. They represent scarcely 1 per cent of the original lobe and, from a physiological aspect, their function would be insignificant in amount. The extreme atrophy of the suprarenal cortex and of the thyroid are the result of the pituitary insufficiency. The atrophy of the ovary, most obvious histologically, is due to the same cause, and the atrophy of the uterus is secondary to the ovarian dysfunction. The peculiar type of atrophy of the myometrium is presumably to be related to superinvolution occurring in a gravid uterus. The reduction of the endometrium to a single layer of epithelium explains why endometrial biopsy is always unsuccessful in these cases (McLellan,[7] Fraser and Smith). Other quite standard findings are the loss of body hair, the good state of general nutrition of the body, and the small size of certain viscera. In this case, the splanchnomicria involved the kidneys to a very marked degree.

Discussion

Patients with fully developed Simmonds's disease of this type often present something of a diagnostic puzzle. Their illness dates from a delivery at which they have been severely collapsed. Afterwards they appear to be suffering from a puerperal debility from which they never convalesce properly, and which is obviously something much more than mere "debility." They have permanent amenorrhoea. They may have little appetite, but usually do not become thin. They are sometimes very pale but blood counts do not show an anaemia severe enough to account for the pallor, and treatment with iron or liver extracts has little or no effect. They have evidence pointing to mild or even severe myxoedema, but they do not improve on treatment with thyroid. Their condition can suggest Addison's disease, but does not show any pigmentation. They are subject to occasional attacks of coma, which are not due to any of the usual causes of coma in general, and which often prove fatal. The general clinical picture thus drawn may seem disappointingly indefinite. There are, however, a number of positive physical signs which, if taken

together, will establish the diagnosis conclusively. There is superinvolution of the uterus, vagina and vulva, a loss of the axillary hair and a thinning or loss of the pubic hair. The superinvolution, and possibly the body hair loss also, may be taken as evidence of loss of ovarian function. The basal metabolic rate is about −30 which is presumably an indication of loss of thyroid function. There is a disappearance of 17 ketosteroids from the urine, indicating loss of function of the adrenal cortex. The insulin tolerance test shows a hypoglycaemia unresponsiveness which results from the deficiency of adrenal cortical hormone, and an insulin sensitivity due to the lack of glycotropic hormone from the pituitary. These last two very important tests have only recently been introduced by Fraser and Smith. The detailed application of the tests to Simmonds's disease is given in their paper; the more general aspects were dealt with by Fraser, Forbes, Albright, Sulkowitch and Reifenstein[8] and by Fraser, Albright and Smith.[9] When there is evidence of simultaneous loss of function of gonads, thyroid and adrenal cortex, combined with the lack of pituitary glycotropic hormone, the diagnosis of very gross loss of function of the anterior pituitary is established beyond reasonable doubt.

This description is based essentially on the facts given in recent reviews (Sheehan[10 and 1]) of the previous literature on Simmonds's disease of this type, with details of the 37 cases with autopsy that had been published at that time. Certain further papers require consideration. Fraser and Smith have recently published an important paper dealing with the 2 objective tests mentioned earlier. In this paper they give full details of 10 patients with anterior pituitary deficiency, of which the first 4 are quite typical Simmonds's disease due to postpartum necrosis of the anterior pituitary. These 4 patients are still alive but the clinical evidence is quite conclusive. Means, Hertz and Lerman,[11] in a paper stressing the hypothyroid aspects of Simmonds's disease, record 6 cases of the present type. Their Cases 2 and 7 dated from a delivery about which information is not given, but the autopsy findings were characteristic. Their Cases 3, 4, 5 and 6 followed postpartum haemorrhage, and postmortem proof was obtained in the last 2 of these. Further details about their Case 2 are given by Castleman and Hertz; their Cases 3 and 4 are also described as Cases 1 and 2 by Fraser and Smith. Their Case 3 is also described as Case 1 by Lerman and Stebbins[12] who record also an additional case which followed postpartum haemorrhage and was proved by autopsy 40 years later. Biggart[13] records 2 cases, in one of which there had been retained placenta and, in the other, some unknown severe obstetric complication. Both were proved by autopsy. Biggart also illustrates 2 pituitaries with postpartum necroses, 1 a week old and the other 2 years old. Pettersson[14] records a case with typical obstetric and clinical history; the autopsy findings were characteristic and the pituitary was very small but it was not examined microscopically. Seeger[15] describes a case with autopsy findings and clinical history which are compatible with the diagnosis though the obstetric history is not recorded. Schob and Güntz[16] report a case with acceptable autopsy findings but an indefinite obstetric history; this patient was strikingly emaciated. Cases with very characteristic obstetric and clinical histories but without autopsy are recorded by Stenström,[17] Adler,[18] van Rijsewijk,[19] de Langen[20] (Case 1), van Balen,[21] and Williams and Whittenberger[22] (Case 1). Possible clinical cases are also noted by Karrenberg,[23] Loos,[24] and Mogensen[25] (Case 3). An article by Vignes[26] on the subject is not at

present available. Escamilla and Lisser[27] review the literature on Simmonds's disease and anorexia, and give a very extensive bibliography. (They had published a short abstract of their main findings earlier[28].) From a personal study of the original case reports it appears that some of the cases they review can be accepted as true and uncomplicated cases of Simmonds's disease, some are grossly complicated by neoplasms which involved the hypothalamus, whilst in the rest, a large percentage of the total, there is nothing to suggest that any pituitary lesion had occurred. Their conclusions are thus not to be accepted without a very critical analysis of the actual cases on which their review is based.

The best line of treatment of these cases is still not fully worked out. The production of a subsequent pregnancy leads to definite clinical improvement (Sheehan and Murdoch[29]). Endocrine substitution therapy has recently given some very promising results in the hands of Williams and Whittenberger and of Lerman and Stebbins. There is also some indication that the crises may be avoided by keeping the patient on a high salt diet and by insisting that she shall never go a single day without adequate food intake.

Summary

A case is reported of Simmonds's disease due to postpartum necrosis of the anterior pituitary. The clinical course was quite typical and, as is usual in these cases, the patient remained well nourished. She died 6 years after the delivery. At autopsy all the characteristic changes were found.

The recent literature on the subject is reviewed, bringing the total cases proved by autopsy up to 48.

Our thanks are due to Professor J. Shaw Dunn for his encouragement and advice, and to the following who have kindly supplied the clinical details from which the history of this case was gradually pieced together: Drs. Douglas Adams, Western Infirmary, Glasgow, and Stobhill Hospital, Glasgow; P. M. Birks, Gloucestershire Royal Infirmary; W. G. Birks, Gloucester City General Hospital; G. Browning, Western Infirmary, Glasgow; A. S. Glover, Glasgow; C. Latto, Prince of Wales Hospital, Plymouth; D. Latto, Herefordshire General Hospital; W. A. MacLennan, Western Infirmary, Glasgow.

One of us (N.G.B.McL.) is indebted to the Rankin Fund of the University of Glasgow for a grant in aid of histological expenses.

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Accurate Pelvimetry*

BY

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INTRODUCTION

THE function of pelvimetry by X-rays in the prognosis of labour is not yet appreciated as it should be either by obstetricians or by radiologists. In the use of this diagnostic procedure it is so easy to forget that difficulty in labour, which can properly be attributed to disproportion, is a comparatively rare mischance in obstetric practice.

Now disproportion is a word that is far too loosely used in writings on obstetrics, but if we limit its use to cases in which the expulsion of a fully-flexed foetal head is obstructed by a narrowing of the bony canal of the pelvis at any level we can be certain that disproportion causes difficulty in considerably less than 5 per cent of all labours. The first function then of pelvimetry by X-rays is to diagnose early in pregnancy, or even before marriage, that 5 per cent of patients in whom difficulty may occur so that the labour may be arranged under the best conditions, and so that the remaining 95 per cent may be assured that their confinements are to be free from that one danger at any rate. The recognition of this unfortunate 5 per cent is an exercise in the calculus of probability which can be solved by a statistical appreciation of the variation of the maternal pelvis and the foetal skull and this can only be obtained from a considerable series of accurate measurements. To say, as some writers do, that pelvimetry without cephalometry is valueless is a council of ignorance. The second function of pelvimetry is to assist the obstetrician in making up his mind as to how far he is justified in interfering with the normal course of labour; here cephalometry is essential. In this regard it must constantly be emphasized that a disproportion which is not absolute is only one of many factors which influence the decision, that of two women with a similar degree of disproportion, one may safely deliver herself while the other may require a Caesarean section. Here again a sound opinion must be based on accurate measurements and a statistical view of previous experience and should never be given except in terms of probability; the dictum that pelvimetry by X-rays has made trial labour an improper procedure is certainly not yet justified if it ever will be. Now there is some legitimate doubt as to whether measurement by X-rays is indeed sufficiently accurate for these two purposes, and this paper is an examination of the degree of accuracy which can be obtained by one technique of measurement at any rate. It will be well to give that technique in some detail so that it may be fully appreciated that the statistical method which is used to determine the probable error is really applicable.

THEORY OF THE TECHNIQUE

The technique is a stereometric one, that is it depends on the use of two exposures; it is similar in many respects to that of Hodges.[1] The theory makes use of three simple geometrical propositions which are

* This research is assisted by a grant from the Medical Research Council.

almost self-evident from a consideration of Plate I. The tube with its focus at T is at a height TP above the film, the line TP representing the normal ray; an object at A will then cast a shadow on the film at S; if the tube is now moved parallel to the film to a position T′ the normal ray is T′ P′ and A casts a shadow at S′; SP and S′ P′ are joined to intersect at N. Then:—

(1) SS′ is parallel to PP′ which is parallel to TT′.

(2) AN is perpendicular to the film, i.e., N is the projection of A on the film.

(3) AN is equal to TP × SS′ ÷ (SS′ + PP′).

The proof of these propositions is given in Appendix I.

Now it is evident that if this construction were made for all points of a solid object like the pelvis the result would be a right projection of the object on the film, such as would be produced if the tube were at an infinite height above the film, with this addition that the height of any point in the object above the film can be accurately ascertained if the focus-film distance, TP, and the tube-shift, PP′, are known and if the shadow-shift, SS′, is measured. It might be well to state here that I use a focus-film distance of 80 cms., and a tube-shift of 10 cms. Applying this to pelvimetry it is obvious that the length of any diameter is the length of its projection on the film provided that its terminals are at the same height above the film; if they are at different heights this will be recognized by a difference in their shadow-shifts, and the length of the diameter will be the hypotenuse of a right-angled triangle the other sides of which are (1) the length of the projection on the film and (2) the difference of height of the two terminals. This theory is, of course, not limited to pelvimetry, it forms the basis of a method for the rapid location of foreign bodies, and it could be used for any anatomical measurement.

Application of the Theory

I have[2] published my opinion that five measurements only are necessary for the prognosis of labour; (1) The obstetric conjugate, and (2) the transverse diameter at the brim, these give the area of the opening at the brim; (3) the diameter between the ischial spines and (4) the pubosacro-coccygeal diameter which give the area at the plane of least pelvic diameter; (5) the subpubic angle. I have shown, and my findings have been confirmed by Ince and Young[3] that the use of the forceps in labour is more closely associated with contraction of this angle than with any other measurement of the pelvis, and it seems clear that a system of pelvimetry is not complete which fails to give an accurate value for the pubic angle. The first three measurements may be made from the usual films taken with the brim roughly parallel to the film, and the last two may be made from films taken with the brim roughly at right angles to the film. The layout for these two positions is shown in Plates II and III; as it is not necessary with this technique to stress accuracy of positioning, attention has been concentrated rather on rapidity and ease of positioning. The Bucky diaphragm is supported at an angle of 35° to the horizontal which corresponds to the angle of average tilt of the pelvis, so that with the patient recumbent and with the buttocks closely apposed to the diaphragm the first position is reached; for the second the patient abducts the thighs, sits up, and leans as far forward as possible. Both positions are easy to secure and to maintain, and undressing beyond the removal of metal parts of the clothing is not required. The resulting films are shown in Plates IV and V; and it can be seen that these two positions will give shadows of the foetal head from which measurements of the biparietal and suboccipito-bregmatic

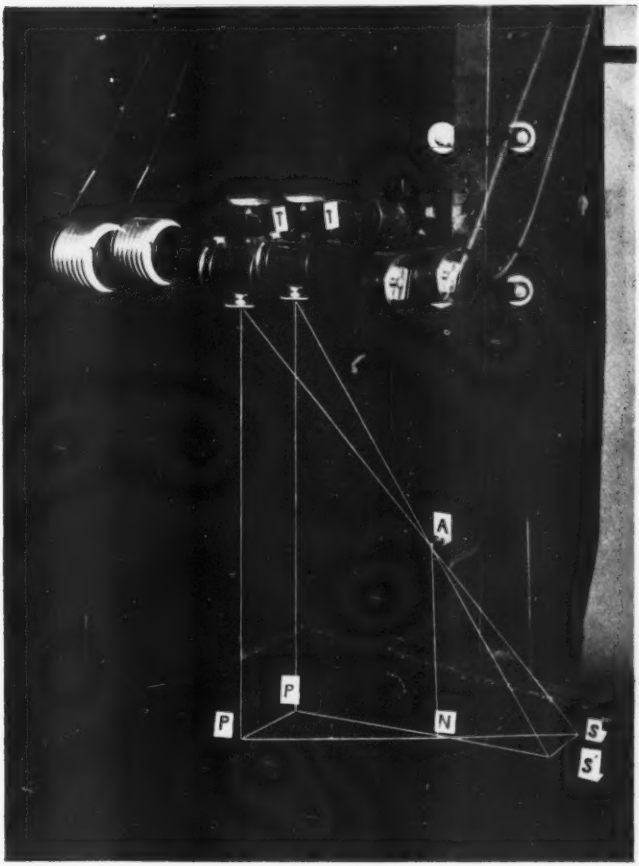

PLATE I
The geometry of stereometric measurement.

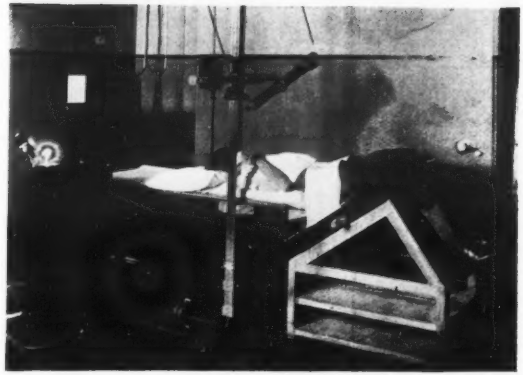

PLATE II
Lay-out for radiography of the brim of the pelvis.

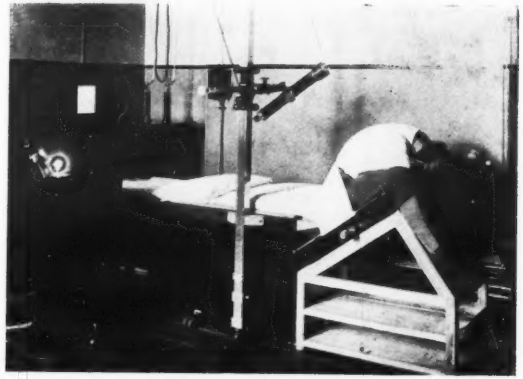

PLATE III
Lay-out for radiography of the outlet of the pelvis.

C.N.

PLATE IV
Radiograph of the brim.

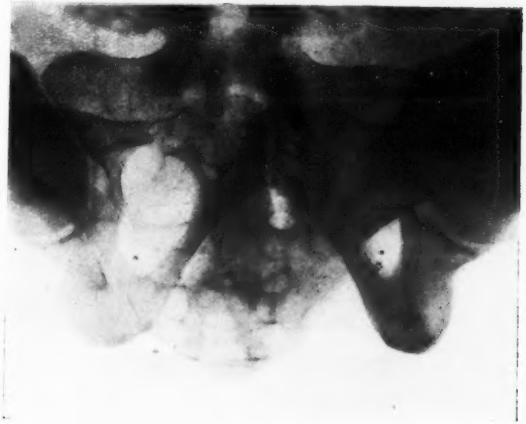

PLATE V
Radiograph of the outlet.

diameters may be accurately made. Small lead markers are inset in the centre line of the diaphragm at a distance of 5 cms. from the centre (these are shown clearly in Plates IV and V), and the tube is centred so that at the limits of shift, the normal ray passes through these points; marks on the tube-stand, cross-arm, and stub make it easy to repeat this centring at will. It is possible, but rather confusing, to make both exposures on one film; in practice two films are exposed in each position and these are marked left and right during exposure.

The right film is set up on the viewing box with a piece of tracing paper so that the edge of a T-square passes through the shadows of the lead markers; a line is drawn through these and the left-hand shadow is marked P, a point on the line 10 cms. to the right is marked P′. The outline of the pelvis is drawn and the terminals of the required diameters marked; through these points lines are drawn parallel to the tube-shift by means of the T-square. The tracing is now superimposed similarly on the left film so that the point P′ coincides with the shadow of the right-hand marker and the line PP′ passes through the other shadow. The parallel lines now pass through the shadows of the same points on the left film and these are marked; the intersecting lines, SP and S′ P′, are ruled and the projection is complete; the projections of the diameters may now be measured. Examples are given in Plates VI and VII. The shadow shifts are measured and any difference in height of the terminals is calculated, and the diameter corrected accordingly. It should be noted that the arithmetical work can be rendered unnecessary by the use of a table for the height and a nomogram for the calculation of the hypotenuse. For all the diameters except the pubo-sacral this correction is rarely necessary as the difference in height must exceed 10 mm. before it need be taken into account; it is never necessary in the case of the pubic angle.

The Probable Error of Observation

Measurements made by this technique, which has now been used in over 600 cases, are stated to the nearest millimetre; this unit of measurement is very necessary for statistical work and it is essential to discover how far the claim to this degree of accuracy is justified. Chassar Moir[4] expresses his doubt in these terms "some methods (such as that of Dr. Nicholson in this country and the recently described methods of Hodges of Chicago) aim at high accuracy," and this legitimate scepticism must be satisfied; it must be shown that the method not only aims at, but achieves high accuracy. The first source of error would be in the setting up of the tube, couch, and diaphragm, because the technique does undoubtedly depend on the accuracy of the two constants, the focus-film distance and the tube-shift. Now it is not very difficult to prove mathematically that any error of a magnitude which is likely to occur in these constants would have an effect of the order of 0.1 mm. on the measurement of any diameter, so that we may legitimately dismiss this source of error. Faulty positioning of the patient, like poor quality of the films taken, will have the effect of making the films more difficult to read but has no real effect on the accuracy. The main source of error without doubt lies in the interpretation of the films, the recognition of the terminals of the diameters, and in the use of draughtman's tools and scales. This error is purely a personal one, and any observer is just as likely to make a measurement too large as too small; the error is indeed a true error of observation and should conform to the mathematics of the error

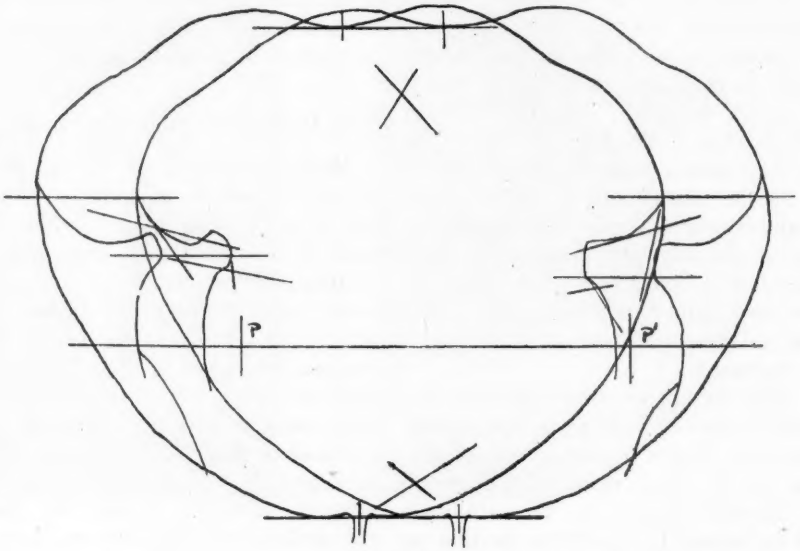

PLATE VI
Stereometric tracings of the brim.

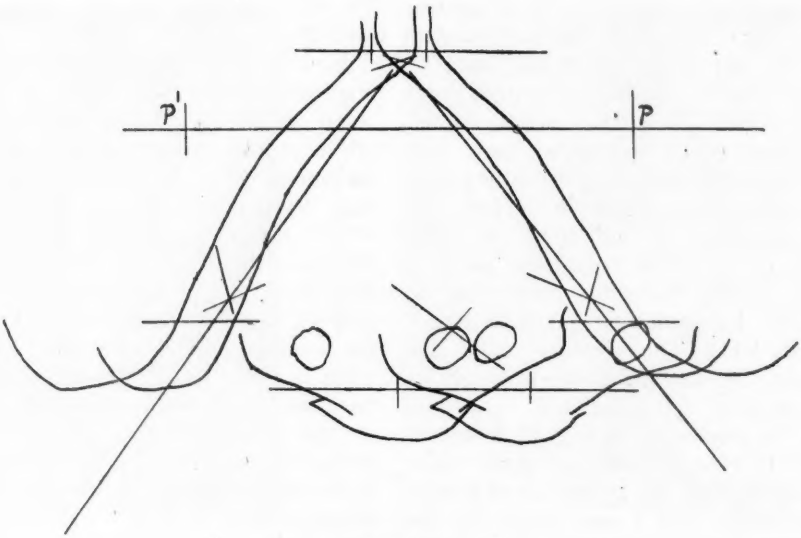

PLATE VII
Stereometric tracings of the outlet.

function. That being so it permits the use of an interesting statistical technique to determine the amount of the probable error of any two observers; the theory of the technique is given in Appendix II. It is obvious that the two observers must make their measurements quite independently of each other. In my case the second observer has been a secretary, Miss B., who, while of more than average intelligence, was quite ignorant of anatomy and quite unskilled in the use of draughtsman's tools. After a period of instruction in the technique lasting a few weeks, Miss B. was asked to measure 30 sets of films and to tabulate her results without referring to the results which I had previously obtained. From these measurements the probable error of both observers was calculated as in the table below.

	Probable Error of Accuracy	
	N.	Miss B.
Conjugate (mm.)	0.24	1.04
Transverse (mm.)	0.65	0.95
Ischial spines (mm.)	1.30	2.96
Pubo-sacral (mm.)	1.66	3.68
Pubic angle (degrees) ...	1.04	1.05

"Probable Error" has, of course, a precise significance; one half of the observations are likely to have an error less than the probable error, the errors in the other half are likely to exceed it, and an error of thrice the probable error is not likely to occur oftener than twice in 100 measurements. It is now possible to say that the claim to give measurements of the diameters to the nearest millimetre is, on the whole, justified. Further it appears that knowledge of the anatomy of the pelvis and a familiarity with the technique for 10 years give less advantage in accuracy than might be expected. Skill in the technique, however difficult it may seem at first sight, can be acquired in a very short time indeed.

Conclusion

Scientific research in any subject has only two lines of approach, (1) the accumulation and examination of statistical material, and (2) the carrying out of a planned experiment; for both these purposes accurate measurement and biometric methods are absolutely essential. This truism must come to be accepted in the ward as it is already universally accepted in the laboratory. In this respect research into the value of pelvimetry by X-rays in the prognosis of labour is in a lamentable state. Greulich and Thoms[5] have accumulated a great deal of material which is shorn of most of its value for lack of biometrical examination. Caldwell and Moloy[6] have tried to relate difficulty in labour to the shape of the pelvis, but their classification of the pelvis depends on purely subjective impressions and accurate measurement is simply not used. Chassar Moir uses a full scale outline of the brim and outlet of the pelvis on which he superimposes an outline of the foetal head, but here again his judgment as to the course of labour is purely subjective and appears to take little account of alteration of shape of both foetal head and maternal pelvis under stress. O'Sullivan[7] confines himself to a comparison of the conjugate and biparietal diameters from which he assesses the need for Caesarean section.

There is no hope of progress on any of these lines; indeed there is little hope of progress until we have obstetricians who will have the courage, the vision, and the patience to make an extensive use of trial labour combined with biometrics and accurate measurement.

Appendix I.

TP is perpendicular to the plane of the film so that the plane in which the triangle, TPS, lies is perpendicular to the plane of the film; similarly the plane in which the

triangle, T'P'S', lies is also perpendicular to the plane of the film; therefore AN, the intersection of these planes, is perpendicular to the plane of the film.

TP and AN are both perpendicular to PS so that the triangles SAN and STP are similar, and

$$SN:SP::AN:TP,$$
$$\text{similarly } S'N:S'P'::AN:T'P',$$
$$\text{but } TP=T'P',$$
$$\text{therefore } SN:SP::S'N:S'P',$$

and the triangles SNS' and PNP' are similar, and SS' is parallel to PP'.

Again in the similar triangles SAN and STP

$$AN:TP::SN:SP$$
$$::SN:(SN+NP),$$

and in the similar triangles SNS' and PNP'

$$SN:NP::SS':PP',$$

therefore

$$SN:(SN+NP)::SS':(SS'+PP'),$$

and $AN:TP::SS':(SS'+PP')$,

so that $AN=TP\times SS'\div(SS'+PP')$.

Appendix II

Any value, D, of a variable such as a diameter of the pelvis may be written as $\bar{D}+d$, where $\bar{D}$ is a constant, the mean, and where d is the deviate from that mean; if a number N, of observations is made then $\Sigma d=0$, and $\Sigma d^2/N=\sigma_d^2$, i.e. the square of the standard deviation. If now an observer makes a number of measurements of D, any value which he gets, A, may be written as $\bar{A}+d+\alpha$, where $\bar{A}$ is the mean of his observations, d is the true deviation from $\bar{D}$ as before, and α is an added deviation arising from his error of observation. If this observer makes N measurements and these are squared and summed

$$\Sigma A^2=\Sigma[\bar{A}^2+2\bar{A}(d+\alpha)+d^2+\alpha^2+2d\alpha]$$
$$=N\bar{A}^2+\Sigma d^2+\Sigma\alpha^2+2\Sigma d\alpha$$

and $\Sigma A^2/N=\bar{A}^2+\sigma_d^2+\sigma_\alpha^2+2r_{d\alpha}\sigma_d\sigma_\alpha$

but his error of observation is independent of the variation of the true measurement D, and this is true even if the absolute magnitude of α tends to vary with the absolute magnitude of d, so that $r_{d\alpha}=0$, and

$$\Sigma A^2/N=\bar{A}^2+\sigma_d^2+\sigma_\alpha^2$$

For the same series of observations by a second observer

$$\Sigma B^2/N=\bar{B}^2+\sigma_d^2+\sigma_\beta^2$$

If we now sum AB we have

$$\Sigma AB=N\bar{A}\bar{B}+\bar{A}\Sigma(d+\beta)+\bar{B}\Sigma(d+\alpha)$$
$$+\Sigma d^2+\Sigma d\alpha+\Sigma d\beta+\Sigma\alpha\beta$$
$$=N\bar{A}\bar{B}+\Sigma d^2+\Sigma\alpha\beta.$$

and $\Sigma AB/N=\bar{A}\bar{B}+\sigma_d^2+r_{\alpha\beta}\sigma_\alpha\sigma_\beta$

but the errors of the two observers are purely personal and must be independent so that $r_{\alpha\beta}=0$, and

$$\Sigma AB/N=\bar{A}\bar{B}+\sigma_d^2$$

It follows that

$$(\Sigma A^2/N-\bar{A}^2)-(\Sigma AB/N-\bar{A}\bar{B})=\sigma_\alpha^2$$

and similarly for the second observer; and the probable error of each observer may be calculated. It should be noted that it is implicit in this procedure that $\bar{A}=\bar{D}=\bar{B}$ within the limits of normal error due to the two errors of observation, so that no conclusion is valid if $\bar{A}-\bar{B}$ exceeds twice the value of $\sqrt{(\sigma_\alpha^2+\sigma_\beta^2)}/\sqrt{N}$.

The table below gives the sums for the five measurements of the pelvis, and the work for the conjugate is added as an example.

	ΣA	ΣA^2	ΣAB	ΣB^2	ΣB
Conjugate (mm.)	3649	445887	444545	443284	3638
Transverse (mm.)	3954	522466	522702	523026	3956
Ischial Spines (mm.) ...	3159	334277	334693	335798	3164
Pubo-sacral (mm.)	3945	521049	417843	515726	3922
Pubic Angle (degrees) ...	2585	224275	224979	225830	2594

The Conjugate,

$\bar{A}=121.63$	$\Sigma A^2/N=14862.90$	$\Sigma AB/N=14818.17$		$\Sigma B^2/N=14776.13$	$\bar{B}=121.27$
	$\bar{A}^2=14794.67$	$\bar{A}\bar{B}=14750.07$		$\bar{B}^2=14705.60$	
	$\sigma_d^2+\sigma_a^2=$ 68.23	$\sigma_d^2=$ 68.10		$\sigma_d^2+\sigma_\beta^2=$ 70.53	
	68.10			68.10	
	$\sigma_a^2=$ 0.13			$\sigma_\beta^2=$ 2.43	
	$\sigma_a=$ 0.36			$\sigma_\beta=$ 1.56	
	$0.67449\sigma_a=$ 0.24			$0.67449\sigma_\beta=$ 1.04	

$\bar{A}-\bar{B}$ is 0.37 and $2\sqrt{(0.13+2.43)}/\sqrt{30}$ is 0.58 so that the method is applicable.

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Gangrene Occurring During the Puerperium

BY

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GANGRENE as a complication of the puerperium is noteworthy on account of its rarity, and because of its grave complications.

Obscurity surrounds the aetiology of the condition. The more so by virtue of its rarity. It is the purpose of this paper to review all the cases reported in the literature, 110 in all, to add notes on an additional 13 collected from various sources by myself, and 1 case which came under my own care.

CASE REPORT

On November 22nd, 1940, Mrs. X, aged 34, having had one child previously, was admitted to the Cleland Hospital, Lanarkshire, suffering from phlegmasia alba dolens. She had been delivered 10 days earlier, after a normal pregnancy, of a healthy full time child, the labour being normal.

The previous health and family history were good.

Four days before admission she complained of weakness, and cramp-like pains in the calf muscles of the left leg, with subsequent discoloration of the ankle and swelling of the whole limb. Similar pains developed at the same time in the right leg. On admission her temperature was 101.8°F., pulse-rate 140, and respiration-rate 28. The patient looked extremely ill and very toxic. Her mucous membranes were blenched, and her tongue dry and coated. The left leg was swollen from the groin to the toes, and oedema had spread over Poupart's ligaments to fill the left iliac fossa. Both femoral and popliteal pulses were absent, and the entire left foot and ankle were dusky to the point of blackness. The foot was cold and anaesthetic to light touch, pain and temperature, but muscle joint sense remained. There was also some oedema of the right ankle.

By November 25th a line of demarcation had appeared on the left leg a hand's breadth above the ankle, and the foot showed gangrene of a mixed type. The patient was gravely ill. The right leg, however, improved and the oedema subsided. Tenderness was pronounced in the left iliac fossa.

The lochia was normal, and the uterus not enlarged. There was no abnormality at any time in the heart so far as could be detected.

Blood culture was negative. The patient died on November 27th.

Summary of Autopsy Report. At the post-mortem examination 12 hours after death, I found considerable hypostatic congestion of the bases of both lungs. The heart and great vessels were normal.

All the abdominal viscera were healthy with the exception of the right kidney which showed a moderate degree of pyelitis. There was marked congestion of the veins of the left broad ligament, but they were not thrombosed. The left Fallopian tube was adherent to the left ovarian vein.

The left common iliac, left external iliac, and left femoral veins were engorged with organizing thrombus, and showed acute thrombophlebitis. There was purulent inflammation of the surrounding tissues.

The left leg was disarticulated at the hip and removed for dissection.

Summary of Dissection. The long saphenous vein showed engorgement throughout its length, and was filled with organising thrombus which extended into all the larger superficial tributaries. The thrombus was in direct continuity with that of the femoral vein.

The short saphenous vein showed similar

changes, and here the thrombus formation terminated at the junction with the popliteal vein. The femoral vein below the union with the long saphenous vein was quite normal save for a small patch of early thrombophlebitis in its course through Hunter's canal. The popliteal vein was macroscopically normal, but the anterior tibial veins showed acute thrombophlebitis, as did the posterior tibial veins. The perineal veins were normal to macroscopic examination as were the arteries of the lower limb. There was no history of ergot having been used excepting a dose of the liquid extract, 2 drachms, after delivery.

A second case was reported to me by the courtesy of the superintendent of Stobhill Hospital, Glasgow, and Dr. Bruce, County Hall, London, made an extensive enquiry over the London County Council Hospitals, and reported 1 case which occurred in St. Stephen's Hospital in 1937. This had been investigated in the most minute detail but it is not proposed to recount the result here, rather shall it be considered with the others as a whole.

Lastly, through the kindness of Dr. Charlotte Douglas of the Department of Health for Scotland, Edinburgh, facilities were afforded to study the schedules of puerperal deaths for Scotland during the period October 1929 to 1940. Six hundred and seventy-seven schedules were studied for this purpose. The deaths included all those occurring as a result of childbirth, and among them were discovered 11 in which gangrene was present as a terminal event.

Of these 13 cases 11 were fatal. Six occurred in multipara and 7 in primipara, while 1 followed abortion, and 1 a ruptured ectopic pregnancy at the 3rd month. So far as can be ascertained there is no report in the literature of gangrene having followed rupture of an ectopic pregnancy. The condition was preceded by phlebitis of the right foot developing in the 2nd week after operation.

One case followed for Caesarean section, and B Welchii was here responsible, but the remaining 10 were at term. Sepsis was present in 12 and of the organisms isolated, either from the blood or from the cervix uteri, the most common were streptococci, but B. Welchii was implicated in 4 cases.

Discussion

Analysis of these 124 cases reveals that 111 followed delivery at term, 9 followed abortion, 3 Caesarean section, and 1 a ruptured ectopic pregnancy. Sepsis was present in all the abortions and in 36 of the remaining cases. Information regarding the presence or absence of sepsis is lacking in 50 cases, and in 29 sepsis was not detected.

Ergot or an ergot preparation was definitely a factor of importance in 25 cases, while in 20 of these the drug was administered in the presence of gross sepsis. In one series (Benson[1]) of 7, ergot preparations in 5 were considered to have played a part.

In at least 5 cases gangrene was a sequel to either thrombophlebitis or phlegmasia alba dolens, in 1 endarteritis was assumed to be the cause (Tol[2]) and in 2 (King, Miller, Hauser[3]) it was embolic. Four of the cases were clearly due to the B. Welchii and all of these terminated fatally.

The gangrene most commonly affects the lower limbs but may also affect the upper. In my own series of cases I found the lung, vulva, and perineum affected, and in the cases due to B. Welchii infection, many of the abdominal viscera. That the condition is excessively rare cannot be disputed. Of 148,000 deliveries in the London County Council during a 10 year period, only 1 case of puerperal gangrene could be traced, and of 677 puerperal deaths in Scotland occurring between October, 1929, and

January, 1940, only 11 were complicated by gangrene.

Signs and Symptoms

The disease commonly begins between the end of the 1st week of the puerperium and middle of the 4th, and generally affects one or more extremities. The upper limbs are less frequently affected than the lower.

Symptoms and signs of the local condition are those of ischaemia, and occur in the presence of a puerperium complicated by sepsis or debility, rarely in the apparently normal subject. Pyrexia is the rule and the general condition of the patient is bad. She is a poor anaesthetic risk. The gangrene may be of the dry or moist types, and is not infrequently mixed.

The lochia is often slightly offensive, and the uterus usually shows a degree of subinvolution, while slight lower abdominal pain may add to the patient's misery.

The patient is usually a multipara, and frequently the antenatal period and delivery have been normal.

Treatment

Prodromal signs suggestive of imminent vascular obstruction developing during the puerperium indicate that the limb should be kept warm and completely at rest.

If there is any suspicion that ergot or its preparations have been used in appreciable doses the drug must be stopped and acetyl choline substituted for it.

Attention must be directed to the uterus itself, and any local septic condition dealt with vigorously. The same applies to any obvious point of focal sepsis generally.

Should phlegmasia or thrombophlebitis be present, amputation should not at once be performed, but expectant measures adopted until the local condition has improved and a clear line of demarcation formed. When the general condition warrants amputation this may be carried out at the site of election, bearing in mind that the patient is a poor risk and that speed is essential.

Prophylaxis. Ergot should not be used in the presence of sepsis.

Prognosis

Of a series of 83 cases in the literature 44 ended fatally, and of those which recovered, only 4 avoided amputation. The condition lasts a varying number of days, but if death supervenes it does so frequently after 7 to 10 days, while if amputation is carried out at the optimum moment, when the general condition is improving, the outlook is improved.

The prognosis is also improved by conservative treatment in the first instance.

Aetiology

Several theories have been advanced. Rosenow[4] in 1927 described a haemolytic streptococcus associated with diplo streptococcus in 1 case, which, when injected into animals caused a loosely attached thrombus to form in the large vessels. King, Miller, and Hauser likewise isolated a diplo streptococcus from thrombus present in the veins of their patient. These are the only reported attempts to investigate the bacteriology of the thrombus, and more work along this line might be productive of useful information.

Stein[5 6] believed that there may be a lesion of the vascular endothelium due to the action of toxins from bacteria, in addition to the altered state of the blood during the puerperium predisposing to thrombus formation. This also is in accord with the views of Rosenow. Here it is worthy of note that sepsis need not be confined to the uterus or adnexia. Focal sepsis, for instance, in tonsils and nasal sinuses, could provide the necessary reservoir of toxins.

The part played by ergot and its preparation is of interest. In the case reported to me by Dr. Bruce, ergot was clearly the cause. Yater and Cahill,[7] Saenger,[8] McNalley,[9] and Roche[10] also attribute the gangrene to the use of ergot in cases seen by themselves. It is however certain that although ergot can and does, on occasion, cause gangrene it does not account for the vast majority of the cases under discussion.

A matter of interest is that varicose veins have seldom been present, and that the Wassermann reaction is usually negative, thus ruling out the effect of the spirochaete on the vessel walls as a predisposing factor.

There are several aetiological factors and these may be considered as follows:

1. *Predisposing causes.* Of these, sepsis is dominant and was present in gross form in 45 of the total series of 124. It was considered to be absent in 29, and in the remaining 50 information was lacking.

Secondly may be considered all debilitating conditions, and of these anaemia is the most important. It is accepted that in anaemia blood coagulation is hastened.

2. *Precipitating causes.* The site may be determined by trauma, by local thrombosis, thrombophlebitis, or phlegmasia alba dolens, but in a considerable number of cases the precipitating factor has not been obvious.

The use of ergot in the presence of sepsis may act as specific in a number of instances.

It is possible that a specific micro-organism with an elective affinity for walls of the blood vessel may be the cause in a number of cases.

Lastly, a small group of patients develop gangrene during the puerperium as a result of embolism.

On the basis of the information to hand it is not possible further to suggest the cause of this affection, and additional research with a larger series of cases will be necessary before more definite conclusions can be reached.

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Observations on Shute's Test for Anti-Proteolytic Properties of Human Blood Serum in cases of Abortion, Premature Labour, Accidental Haemorrhage and Normal Pregnancy

BY

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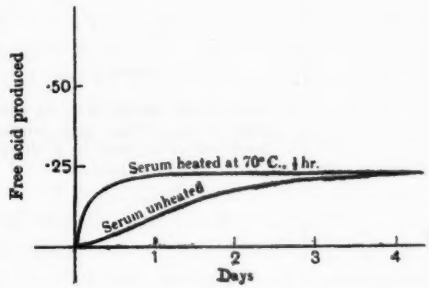
INTRODUCTION

SINCE 1935 Shute[1] has published an interesting series of papers describing an anti-proteolytic power exhibited by the blood serum of women in whom abortion, premature labour, accidental haemorrhage or some of the toxaemias of pregnancy occurred. This anti-proteolytic power is said to be due to excess oestrin in the blood and is often associated with vitamin E deficiency. Shute claimed that these accidents of pregnancy could frequently be prevented by suitable vitamin E therapy. If these claims could be substantiated a tremendous advance in the treatment of many types of abnormal pregnancy would be achieved. Shute's test is based on work published by Wigglesworth and by Fine which may be briefly summarized as follows.

In 1928 Wigglesworth[2] described observations by Cole that when proteins were acted on by proteolytic enzymes the amount of standard alkali required to titrate the mixture to an arbitrary *p*H (say *p*H 8.4) is found to increase as the digestion proceeds. The acidity so measured is termed "free acidity." If the mixture were then treated with neutral formaldehyde the reaction became acid and further additions of standard alkali were necessary to bring the mixture back to *p*H 8.4. This latter acidity is termed "formaldehyde acidity." In the case of the proteolytic enzyme trypsin, the "free acidity" is produced more rapidly in the early stages of digestion but soon reaches a constant level whereas the "formaldehyde acidity" continues to increase.

In 1931 Fine[3] in determining the influence of serum on enzymes, with special reference to its action on trypsin, showed that serum heated at 70°C. for half an hour behaved differently from unheated serum when each was incubated with trypsin. From his experiments he concluded that "serum possesses a property, destroyed by heat, of temporarily retarding the formation of free and formol acid by trypsin, and of subsequently accelerating the formation of formol acid only." Trypsin is stated to consist of two enzymes (*a*) protease giving the rise in free acid and (*b*) peptidase producing the increase in formol acidity. The serum acts against the protease portion of the trypsin. Fine suggests that the free acid is formed as the result of hydrolysis of non-amide linkages, e.g. ester linkages in the

protein molecules. A typical free acid curve is shown in Graph 1.



GRAPH 1

Free acid produced in digestion of 10 per cent serum by 10 per cent trypsin. This shows how free acid produced by inhibited trypsin ultimately equals amount formed by uninhibited trypsin.

This graph is taken from "On the Influence of Serum on Enzymes, with Special Reference to its Action on Trypsin." By Joseph Fine, from the *Biochemical Journal*, Vol. XXV, Part 1, 1931, page 625.

Shute incubated 0.5 c.c. serum from freshly drawn blood in 3.5 c.c. Kolthoff buffer at *p*H 8 with 1.0 c.c. trypsin solution (0.002 per cent) at 32° to 42°C. At 10 minute intervals 0.5 c.c. of the mixture was removed and added to 5 c.c. distilled water containing 5 drops of phenolphthalein. The samples were titrated against freshly prepared N/100 sodium hydroxide, the end point being determined by comparison with 10 c.c. Kolthoff buffer at *p*H 9, containing 10 drops of phenolphthalein. With serum from normal patients typical curves were obtained when the volumes of N/100 sodium hydroxide were plotted against the time (Graph 2).

Very different curves were obtained in similar experiments in which the sera tested were obtained from women in whom abortion, miscarriage, premature labour and accidental haemorrhage had occurred. In such cases the normal action of tryspin was inhibited for longer than 40 minutes, after which time the normal digestion with liberation of free acid took place. Shute carried out parallel experiments on each serum, one sample being heated for 30 minutes at 55°C., the other being left unheated. Three types of results occurred with these experiments on the same serum:

(*a*) Inhibition of digestion of both heated and unheated samples.

(*b*) Inhibition of digestion of the unheated sample.

(*c*) Inhibition of digestion of the heated sample.

(See Graph 3.)

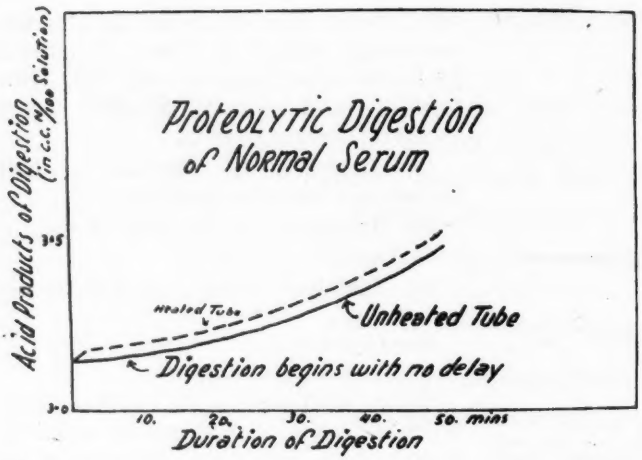
Shute interpreted each of these three types of results as representing inhibition of proteolysis. Sera giving such results lost their anti-proteolytic activity in from 24 hours to 12 days after removal of the blood from the body. In some patients anti-proteolytic power was detected 6 weeks before abortion or other of the specified conditions occurred. If the uterus were curetted the anti-proteolytic power of the serum disappeared rapidly, usually within 2 days, while in spontaneously aborting patients the blood became normally digestible a few days after abortion.

A comparison of the work of Shute with that of Fine shows several outstanding differences:

(*a*) With approximately similar concentrations of serum, Fine uses a very much greater concentration of trypsin, yet the free acid production is of the same order as that found by Shute.

(*b*) While free acid appears to be liberated within 40 minutes in Shute's experiments, graphs in Fine's paper show a gradual rise to a maximum over several hours.

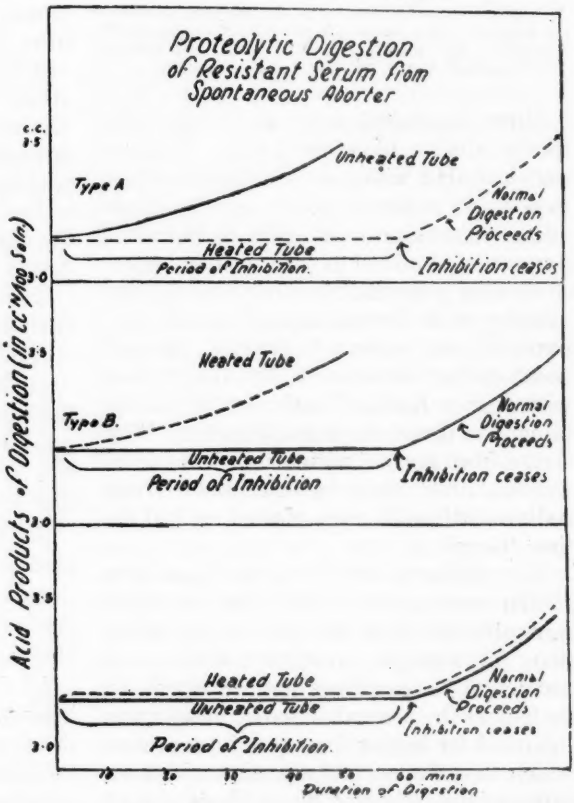
(*c*) Fine observed that heating removed inhibitory substances from serum so that the free acid was always liberated more rapidly in the heated specimen. In Shute's experiments the results obtained bore no



GRAPH 2

Illustrating the digestion of a normal serum, with and without preliminary heating, by a solution of trypsin.

RESISTANCE TO PROTEOLYSIS



GRAPH 3

Illustrating various types of digestion of resistant or inhibitive sera, with and without preliminary heating, by a solution of trypsin.

These graphs are taken from "Resistance to Proteolysis found in the Blood Serum of Aborting Women." By Evan Shute, *The Journal of Obstetrics and Gynaecology of the British Empire*, Vol. 42, 1935, page 1076.

constant relation to whether the serum was previously heated or not.

In spite of these contradictions the obvious advantage of being able to detect the possibility of disturbances of pregnancy prior to their occurrence was so great that it was decided to investigate sera from various types of patients by this method. Tests were performed on sera from 85 patients including normally pregnant women, and those in whom abortion, premature labour and accidental haemorrhage occurred. Several different samples of serum from the same patient were examined in some instances to determine if variations occurred in serum from the same individual.

1. Investigation of Method

In testing Shute's method it was found impossible to obtain consistent results for titrations of free acid against N/100 sodium hydroxide using phenolphthalein as indicator by matching the end point with 10 c.c. of Kolthoff buffer *p*H 9 containing 10 drops of phenolphthalein. Similar difficulty has been reported by Cuthbertson and Drummond,[4] and they used an achromatic indicator with much greater success. This indicator has been found very satisfactory throughout this series of tests. It consists of a mixture of methyl red, methylene blue and phenolphthalein and when added to the water and digest the mixture is clear green. On addition of alkali the indicator goes through a grey shade and finally changes to a violet colour which is matched in a *p*H comparator with the colour developed in 10 c.c. of Kolthoff buffer at *p*H 9 containing an equivalent amount of indicator. The maximal difference between five consecutive titrations on buffer serum mixture was 0.1 c.c. N/100 sodium hydroxide.

2. Experimental Results

(1) *Tests on sera from different types of patients.*

The action of trypsin was tested on sera from 37 normally pregnant women, from 33 women with toxaemias of pregnancy and from 15 women who had threatened abortion, abortion, premature labour or accidental haemorrhage. The results are summarized in Table I.

In 39 experiments there was an increase in free acid during the incubation period, and in 37 others in which the initial acid concentration was greatest the curves showed a downward trend. In 9 cases there were only slight variations in free acid concentration during the experiment.

Table I.

Type of patient	No.	Results of tests for antiproteolytic activity: Increase in free acid within 40 minutes	Decrease in free acid within 40 minutes	No change in acidity
Normally pregnant women	37	19	18	–
Toxaemic pregnant women	33	12	13	8
Women with abortion, premature labour, or accidental haemorrhage	15	8	6	1
Total	85	39	37	9

Only 11 of the 85 curves obtained bore any resemblance to those described by Shute. The rise in acid in the other 28 experiments in which an increase occurred within 40 minutes was usually quite rapid and was followed, in nearly every instance, by a sharp fall. Frequently there was a second rise and sometimes a subsequent fall. The curves were, in general, more like those described by Fine (see Graph I). This resemblance is only a superficial one since his experiments showed the effect of trypsin over a period of several days and the maximal action appears to have taken place during the first 6 hours, while the acidity, in this series of experiments, reaches a maximum within 40 minutes. The curves, therefore, are hardly comparable.

In addition to adhering closely to Shute's method, samples were tested immediately after the various constituents were mixed and also after 5 minutes incubation at 37°C. This procedure was adopted since Wunderly[5] using a nephelometric method, claimed that the main action of trypsin on serum proteins resulting in liberation of free acid took place within 15 minutes. When readings at zero and 5 minutes were included in the series, tests on 35 of the normally pregnant women were classified as follows:

Rise in free acid	11
Fall ,, ,, ,,	13
No change ,,	11

Many of the 19 tests in the normally pregnant group, previously showing a rise in acidity were now characterized by a fall and then a rise, and in some instances by a further rise and fall within 40 minutes. Similar curves were obtained for the action of trypsin on sera from toxaemic patients and from women having abortion, premature labour and accidental haemorrhage. Many of the tests were prolonged to 100 minutes and the curves were similar to those already described. Examination of the results obtained with this test indicated such irregularity that it seemed very doubtful whether the curves obtained were really due to liberation of free acid by the trypsin extracts. For this reason it was decided to test the effects of variation of a single constituent or groups of constituents. Firstly, tests with different samples and concentrations of trypsin were investigated, and secondly, the effect of incubation on various constituents of the final digestion mixture were examined.

(2) *Effect of Variation in Constituents of Digestion Mixture in Shute's Test.*

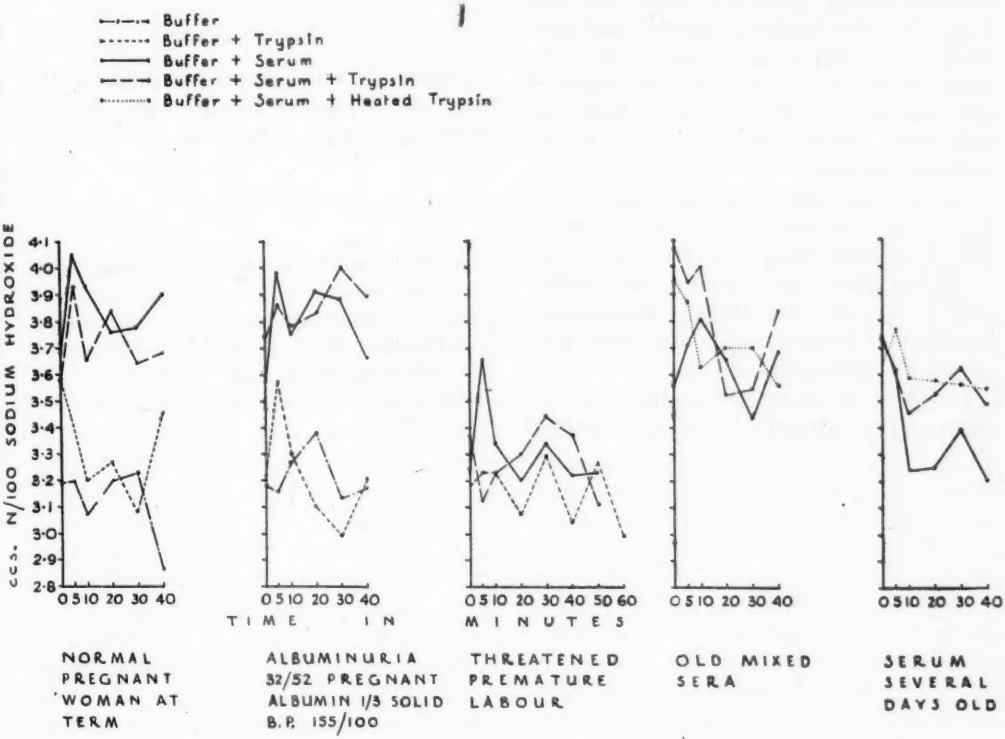
(a) *Tests with different samples and different concentrations of trypsin.* Three different samples of trypsin, each of which had been shown to digest fibrin in alkaline medium, were used in the preparation of solutions for these experiments. Not only was the trypsin used in a concentration of 0.002 per cent as specified by Shute, but in some instances concentrations of 0.01 per cent and 0.05 per cent were substituted. The results did not seem to vary with the concentration or the sample of trypsin used. These observations confirm those of Cuthbertson and Drummond.

(b) *Effect of incubation on buffer solution and mixture of buffer with the various substances used in Shute's test.* In order to test the effect of incubation on buffer solutions and on mixtures of buffer solution with the various substances used in Shute's test, duplicate tubes were set up containing:

(1) Kolthoff buffer solution at *p*H 8 and water.
(2) Buffer solution at *p*H 8 and trypsin.
(3) Buffer solution at *p*H 8 and serum.
(4) Buffer solution at *p*H 8, serum and trypsin,

(5) Buffer solution at *p*H 8, serum and trypsin heated in a boiling water bath for at least 30 minutes.

Constant volumes were attained by the addition of distilled water to the tubes containing fewer ingredients. Duplicate experiments on each mixture agreed very closely. Characteristic examples of curves obtained in experiments using the various mixtures specified are illustrated in Graph 4.



GRAPH 4

These graphs show that even when the buffer solution alone was incubated at 38°C., and samples were removed and titrated under the same conditions as were used in Shute's test, greater fluctuations occurred than those obtained when successive, measured samples of unincubated solution were titrated against N/100 sodium hydroxide. Somewhat greater variations occurred when buffer trypsin mixture was similarly tested. Marked variations occurred when serum from normally pregnant women and buffer were tested, but addition of trypsin to the mixture before incubation caused no increased effect. As a final control the action of trypsin and inactivated trypsin on the same sample of normal serum in buffer solution gave almost identical results. The types of curves in these experiments were similar to those obtained in the series on sera from different types of patients and again there was no possibility of correlating a special type of curve with any combination of constituents in the mixture being tested.

Conclusions

Incubation at 38°C. of the serum of pregnant women with trypsin in buffer solution at *p*H 8 resulted in variations of free acid during a period of 40 minutes but there was no consistency in the type of curve obtained by estimation of free acid at regular intervals. Prolongation of the test to 100 minutes did not affect the types of curves obtained. The results do not support claims recently made by Shute that free acid is liberated under the above conditions within a period of 40 minutes. In some cases there is an increase, in others a decrease and in some instances there are only slight fluctuations in acidity of the incubated mixture.

The experiments show that slight variations occur without serum and it can be definitely stated that the variations are not a tryptic effect since serum and buffer, serum, trypsin and buffer, and serum, inactivated trypsin and buffer each give almost identical curves.

In our experience serum from neither normal nor abnormal patients showed evidence of digestion by trypsin under the conditions specified.

The observations recorded in this paper together with the results of Cuthbertson and Drummond indicate that Shute's test for inhibition of proteolysis is not a satisfactory means of distinguishing women in whom abortion, miscarriage, premature labour or accidental haemorrhage is likely to occur from those whose pregnancy is likely to pursue a normal course.

Acknowledgement

This work was carried out under grant from the National Health and Medical Research Council of Australia.

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Chorionepithelioma

(Some Observations)

BY

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THE pathology and progress of this malignant tumour are so well known, and have so often been described, that at first sight it would not appear necessary to add to its already voluminous literature. However, personal observations may often prove to be of value and interest so it is for these reasons that the authors of this short paper venture to record their observations.

It is an established fact that the tumour starts as the result of over activity of the trophoblastic element of the growing human ovum, and no other theory for its genesis is tenable. Its continuance of growth is dependant upon the life of its embryonal elements, and as long as these remain alive so long does the tumour increase in size. The Aschheim-Zondek and Friedman tests are the most valuable aids to the clinician in this disease for it is well known that the tests become negative some 3 weeks or so after the death of the ovum, owing to the withdrawal of the anterior pituitary like hormones from the urine of the patient.

What is it that causes the trophoblast suddenly to become so excessively active? No one at present knows. Will the secret ever come to light? At present it is as elusive as the etiology of other forms of cancer. It is suggested that it may be due to persistence of corpus luteum hormone; this is reasonable when one realizes that there is excessive luteinization of the follicles in association with moles and chorionepithelioma.[1] Though chorionepithelioma may follow on any pregnancy, yet it is most common following on cases of hydatidiform mole and abortion.[2] Hydatidiform mole is a cystic degeneration of the chorionic villi of the ovum, and so is definitely a pathological condition of the products of conception and one, therefore, ready and potent to grow into a neoplasm. But why does it not always do so? Abortion may be caused by reasons other than pure pathological conditions of the ovum. Does chorionepithelioma arise following abortions due to non-pathological dease of the ovum? The answer is, frequently yes: but it occurs less frequently following abortion than in conjunction with

a mole, and the neoplasm may occur following a full-time pregnancy. The tumour is situated usually in the uterus, but may occur primarily in the vagina, or Fallopian tube.[3]

It is stated that the growth may arise shortly after the termination of the pregnancy, or may not appear for several months or even years afterwards.[4] The authors do not agree with the latter part of this statement and are confident that in patients in whom this seems to have been the case that another, unrecognized pregnancy of short duration has occurred. It is noteworthy that this is in agreement with some of the later textbooks.[5] It is also stated that the tumour usually is of rapid growth but may grow very slowly.

The tumour grows by means of the invading property of the trophoblast, the latter element burrowing deeply into the musculature of the uterus. The endometrium is not invaded by the growth. The trophoblast has already invaded the endometrium in order to form the decidua, but when the chorionepithelioma starts, the endometrium is not further invaded. The essential pathology is an invasion of the deeper structures.

The clinical symptoms so quickly follow a history of an interrupted pregnancy that it is a reasonable supposition the trophoblast grows rapidly; sometimes more rapidly than at others, but we have not been able to find evidence of the "slow growth" described by some writers.[6] Having observed personally several cases during the last 3 years, we cannot bring ourselves to accept the theory that a long interval may elapse between the pregnancy and the onset of the growth. We consider that though the patient and/or her relatives may honestly believe that there has not been a pregnancy for some time, careful questioning will elicit the fact that a short while before the onset of symptoms of the disease, an excessively heavy period took place, or there was a sudden haemorrhage *per vaginam*. This, of course, being a succeeding pregnancy and the direct precursor of the tumour.

We consider that the trophoblast will not invade the uterine tissue to a certain distance and then become dormant only to wake up some time later. The Aschheim-Zondek test would be conclusive evidence, but in the absence of symptoms it is not demanded, and one cannot subject patients to this test, at various times after every pregnancy for many reasons, though no doubt scientifically it would have many adherents. It is interesting to note that as metastases occur, so does the Aschheim-Zondek test become stronger.

For the most part the history of our cases is fairly typical, and pathologically unmistakable. Only one of our cases displayed an extension of the disease, which in this patient invaded the vaginal vault and bladder.

Many authorities, notably Wilfred Shaw and Beckwith Whitehouse comment on the extreme rarity of the condition, which is probably the case in some parts of the world, but in the Eden Hospital it is found to occur as frequently as 0.262 per cent of all gynaecological cases admitted: the number of cases reviewed in this paper being 14 out of a total of 5,712 patients admitted over a period of 3 years. This percentage is higher than most authors state. In 8 of these cases a hydatidiform mole preceded the chorionepithelioma. It is not necessary to give in detail the history of each individual case, but one abridged typical average history is appended, and the abridged histories of 4 special cases. All the cases displayed the usual well-known symptoms of the disease, i.e., the haemorrhage, necrotic sero-sanious discharge, or when metastases occurred, the typical emaciation, and cachecsin.

CASE 1. An average typical history.

Mrs. P. D. (Indian), age 23, 3-para. History of having expelled a mole 3 months ago. Within one month bleeding started. Curettage not advised. Total hysterectomy performed. Result—a typical chorionepithelioma.

CASE 2. Mrs. G. (Indian), age 23, 3-para. History of expulsion of a mole 10 years previously. Since then had 2 normal pregnancies, last one 2 years before admission. Aschheim-Zondek test, positive. Hard lump in lower abdomen.

Hysterectomy, result: chorionepithelioma. It is considered there was a recent pregnancy to account for this condition.

CASE 3. Mrs. P. (European), age 40. Married 16 years, no pregnancy. Admitted with a history of having missed a period; then after 12 days had severe bleeding *per vaginam*. The uterus was enlarged to the size of a 7 weeks' pregnancy. Patient was curetted. Scrapings showed malignant chorion, hysterectomy revealed a chorion-epithelioma.

A very interesting case of the disease occurring in an elderly primipara.

CASE 4. Mrs. M. (European), age 30, 4-para. Admitted for hyperemesis gravidarium. Treatment of little avail, so uterus evacuated. The pregnancy was a mole. After 4 weeks bleeding began *per vaginam*. Aschheim-Zondek test not done as no facility at the moment. Hysterectomy performed and the result was a chorionepithelioma.

An interesting case demonstrating the the extreme rapidity of the growth.

CASE 5. Mrs. M. B. (Indian), age 24, 9-para. Uterus the size of 24 weeks' pregnancy, soft, no foetal parts. While being examined there was a sudden rush of blood. Uterus immediately emptied of a mole. Discharged from hospital on August 29th, 1941. Re-admitted on September 1st, 1941, with history of bleeding from the day before. Hysterectomy carried out next day. Chorionepithelioma was found.

There are some interesting points about some of these cases. Case 3 was a great personal friend of one of us (H.E.M.), who had known her for years. It was, therefore, with astonishment that he recognized her state of pregnancy after so many years of sterility, and it was with consternation that he realized a hysterectomy was necessary. It was with dismay that the patient and her husband learnt of the decision, but they understood at once the gravity of the case and agreed to immediate operation, with the result that the lady is now quite well 3 years after the operation.

Case 4. This is a sad case, as the patient developed a secondary or implantation growth in the vault of the vagina before she had got as far in her convalescence as getting out of bed. The growth involved the bladder so that a vesico vaginal fistula appeared. The patient's husband was told of the gravity of the prognosis so he decided to remove her to Bombay where her parents lived.

Case 5. The interest of this case lies in the fact that the radical operation was performed very early. Macroscopically it was difficult to make out a tumour at all. There was just some thickening. The microscope, however, revealed in full the malignant state.

TREATMENT.

The essential treatment is surgical. Hysterectomy should be carried out as soon as the condition is diagnosed, and this is followed in 3 weeks by a course of deep X-ray therapy. The ovaries may or may not be conserved. Some surgeons advocate leaving them in position as ovarian metastases are rare,[7] but if in order to do one's best for one's patient, deep X-ray therapy is administered after the operation, the ovaries will be rendered inert, so it does not seem a sound surgical procedure not to remove the ovaries at the operation.

There are certain aspects in the treatment of chorionepithelioma. It is spontaneously cured more often than any other known

malignant tumour. Specially after hysterectomy, secondary growths have sometimes disappeared without treatment. But once the resistance to its spread is broken down it runs a more rapid fatal course than any other new growth. After diagnosis is made either clinically, microscopically or by Aschheim-Zondek test in higher dilution, immediate hysterectomy with removal of appendages is necessary. In some clinics, intrauterine radium has been tried. The opinion is unanimous regarding removal of the cystic ovary. In young patients, the other healthy ovary can be left alone; but in patients above 40 both ovaries should be sacrificed. During operation, ovarian and uterine vessels should be ligated or clamped early to prevent dissemination. Deep X-ray therapy of the abdomen and pelvis is to be followed as a routine. Aschheim-Zondek test during treatment is a guide to the cure.

Our observations may be summarized as follows:

1. The most complete uniformity of of history and symptoms. That is, haemorrhage *per vaginam* commencing soon after the termination of treatment for the removal of products of conception, whether mole, abortion or later pregnancy; or following on an excessively heavy period. In only one case was there a history of a long period of time since the last pregnancy or heavy period.

2. The rapid rate of growth of the neoplasm. This was noted by observing the size of the tumour in relation to the duration of symptoms.

3. The high degree of malignancy. This was noted by the invasion of the tissues as seen microscopically, having due regard to the duration of the symptoms.

4. The excellent response to treatment when uncomplicated by metastases.

5. The deleterious effect that metastases caused.

6. The extreme usefulness of the Aschheim-Zondek test. Actually the Aschheim-Zondek test was not the one carried out by us owing to the difficulty of getting mice. We used the Friedman test, but this also was not always possible. The Hospitals and Institutions in India have not got the large animal departments which exist in other places, so that animals are not kept and bred on the spot, and so ready for use at any time. On each occasion the rabbits had to be acquired specially, which meant extremely careful preliminary watching of the animals.

Our thanks are due to Dr. B. P. Tribedi, M.B., D.B. (Lond.), Professor of Pathology, The Medical College, Calcutta.

To Dr. S. Hazra, L.R.C.P., M.R.C.S. (Lond.), F.R.C.S. (Edin.), Registrar, The Eden Hospital, Calcutta, for the notes of the cases.

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Multiple Primary Cancers of the Uterus

BY

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CULLEN[1] devotes a chapter of his work on "Cancer of the Uterus" to the 'Coincident Appearance of Carcinoma in the Cervix and in the Body of the Uterus,' but after reviewing the 6 cases which were then on record, decided that not one of them provided conclusive evidence of multiple primary malignancy. He points out that before such an assumption is justified, the possibility of one growth being a direct extension or a metastasis of the other must be excluded, and in the uterus this is often difficult.

A uterine carcinoma may penetrate the myometrium to appear on the mucosa at some distant point, and Jellett[2] has recorded such a case, in which fundal and cervical growths, separated by normal endometrium, were shown to be connected in the uterine musculature. A corporeal cancer may be responsible for a cervical metastasis either by retrograde lymphatic flow, or by the implantation of carcinomatous fragments in the mucosa of the cervical canal. It is also acknowledged that extension of carcinoma of the cervix by metastasis, both into the substance and also into the mucosa of the corpus is not rare.

It is evident, therefore, that before two cancers occurring in the same uterus may be regarded as separate malignant processes, they must possess distinct histological characters. They must, moreover, arise in different situations and be clearly independent. Carcinomata composed of an admixture of glandular and squamous elements do not enter this category. Irregular areas of epitheliomatous tissue are commonly seen in corporeal adenocarcinomata, particularly in those of the lower degrees of malignancy, and adenoacanthomata have also been described in the cervical canal and portio. The adenocarcinoma usually constitutes the bulk of the tumour, but occasionally the squamous portion of the growth is predominant. Adeno-acanthomata are now regarded as single tumours, in which certain of the cancer cells have displayed an extreme power of polymorphic growth.

The following case is presented as one of double primary uterine carcinoma, in which the above criteria in regard to locality and histological type, are fulfilled.

Mrs. G. H., 47 years of age, was admitted to the Cardiff Royal Infirmary in September, 1941. She had one child, 11 years old, and complained of continuous vaginal bleeding for 9 months, and more recently of lassitude, weakness and considerable loss of weight. On pelvic examination it was noted that a bleeding, soft, friable, polypoid mass filled the cervical canal, and was presenting at the widely dilated external os. The vaginal surface of the cervix was healthy. The body of the uterus was slightly enlarged and firm in consistence. As the case was regarded as one of corporeal cancer, the uterus was removed together with the appendages and a segment of the vagina. Convalescence was uneventful.

Pathological Description

The uterus was uniformly enlarged, and with the cervix measured 9.5 by 8 by 5 cm. The appendages were normal. The specimen was bisected antero-posteriorly, and showed the appearance presented in Fig. 1.

The entire corporeal endometrium is involved in a difuse type of adenocarcinoma, and presents a thickened, irregularly polypoid appearance. There is no macroscopic penetration of the myometrium, but histological examination reveals scattered deposits of adenocarcinoma deep in the uterine wall. The growth is characterized microscopically by enlarged glands lined by several layers of cuboidal and cylindrical cells with dark hyperchromatic nuclei (Fig. 2).

The cervical canal is occupied by an exophytic squamous-cell carcinoma measuring 4.5 by 4 by 2.5 cm., growing from its anterior wall. The tumour has a narrow base, and here invasion of the cervical musculature is evident to the naked eye as a translucent greyish white area (Figs. 1 and 2b). Patches of necrosis are visible in the lower pole of the tumour. Microscopically, the growth is composed of round and polyhedral cells, without pearl formation or keratosis (Fig. 3). Prickle cells were not seen.

The boundaries of the squamous and glandular cancers are shown diagrammatically in Fig. 4. The demarcation of the tumours was clear cut, and any suggestion of transition from one to the other could not be detected.

Multiple Primary Malignancy

The occurrence of multiple primary malignant tumours in the same individual has been a subject of considerable interest for many years. Until the beginning of the present century, it was regarded as an extremely rare phenomenon, but the more complete investigation of neoplastic diseases of recent times has resulted in numerous reports of larger or smaller series of cases of this condition.[3, 4, 5] Warren and Gates[4] found 40 instances of multiple primary malignancy in the course of 1,078 postmortem examinations on patients dying of malignant disease, and after an exhaustive search of the literature collected and analysed a total of 1,259 cases. These authors came to the conclusion that multiple primary malignant tumours occurred more frequently than could be explained on the basis of mere chance, and this view has since been supported by Bugher[6] and Burke.[7] These statistical studies have also shown that the incidence of multiple primary malignant tumours in paired organs (breasts, ovaries, testes) and in functionally related organs (breast, ovary, uterus) is much greater than the normal expectancy.

Multiple malignant tumours of the same organ is much more rare than the incidence in different organs of the same individual,[4, 5] with the exception of the skin, where Ward found 5.3 per cent of rodent ulcers to be multiple.[8] Other organs affected by multiple primary malignant tumours, in order of frequency, are the large intestine, pharynx and stomach.[4]

There are relatively few reports of multiple primary malignant tumours occurring in the uterus, where it seems that the most common combination of malignant tumours is that of carcinoma and sarcoma. Hertel[9] found carcinoma of the cervix in 8 of 29 cases of uterine sarcoma.

The simultaneous growth of two carcinomata with distinct morphological characters in the same uterus is very rare, and according to Frank,[10] there was no case on record in 1931. In 1935, Gold-

FIG. 1.

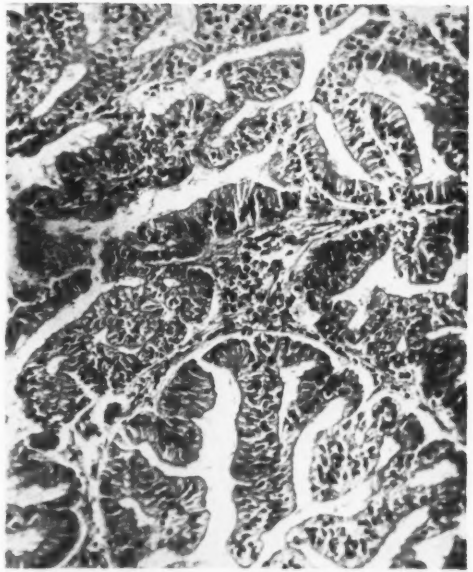

FIG. 2.

R.G.M.

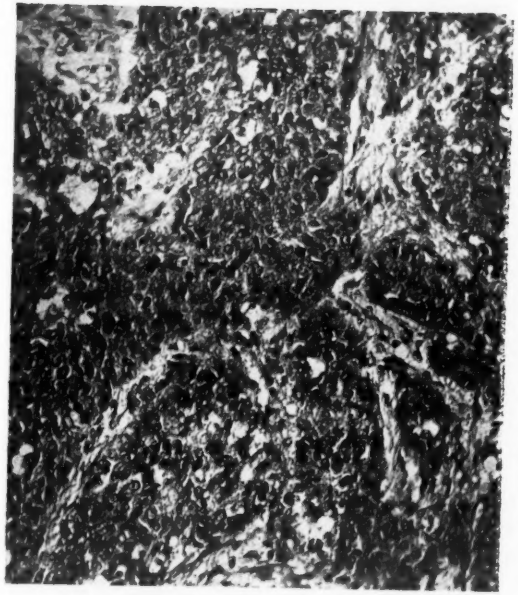

FIG. 3.

R.G.M.

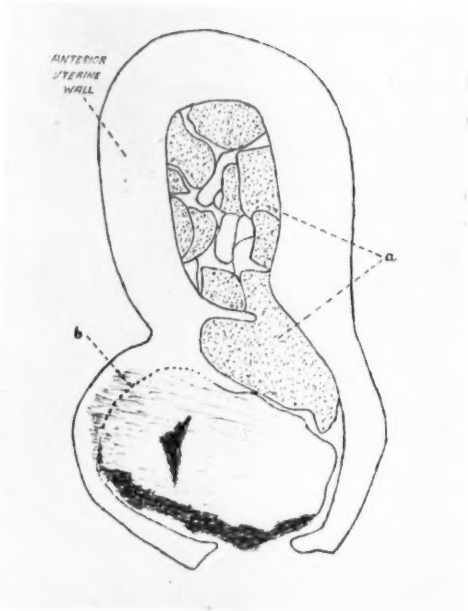

FIG. 4.

a. Adenocarcinoma.
b. Squamous cell carcinoma.

stine[11] reported a case of squamous carcinoma of the portio and adenocarcinoma of the fundus. In 1936, Counseller and Butsche[12] describes 2 cases—one in which a mixed epithelioma and adenocarcinoma was found at the internal os, and an adenocarcinoma in the left cornu, and their second case presented a combination of adenocarcinoma, grade 3 of the cervix and adenocarcinoma grade 2 of the fundus. In 1939, Smith and Masson[13] recorded a unique case of epithelioma of the cervix and an adenocarcinoma arising in a uterine adenomyoma.

The main interest of studies in multiple malignancy lies in the light they may shed on individual resistance or susceptibility to cancer, and to the *rôle* played by heredity in this disease. They indicate that an individual affected by one malignant tumour provides fertile soil for the development of other dissimilar tumours, and these occur too frequently to be regarded merely in the light of coincidence. This may imply, as Bugher suggests, that the risk of acquiring cancer is not spread uniformly over the entire population, and that only a certain section of it either has a susceptibility to the disease, or is exposed to some influences favouring its development.

When two primary tumours affect the same organ, Ewing[14] considers that in some cases, the second tumour may result from local conditions brought about by the presence of the first. In almost all reports, multiple primary malignant tumours of the uterus were synchronous, and were recognized after hysterectomy, but recently Jacox, Major and Baker[15] described a case in which a mixed tumour composed of adenocarcinomatous, epitheliomatous and sarcomatous elements developed in the lower segment of the uterus, 16 years after an epithelioma of the cervix had been successfully irradiated. The risk of an individual affected by one cancer, developing another independent malignancy in later years is substantially reduced by the short expectancy of life caused by the first tumour. The risk of such an occurrence in the same organ, such as the uterus, has in the past been largely eliminated by the surgical extirpation practised for the initial malignancy, but with the wide adoption of radiotherapy for uterine cancer, it is probable that metasynchronous primary malignant tumours of the uterus will be more frequently observed.

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Photograph taken post-mortem showing destruction of lumbar, sacral and perineal areas; exposure of rectum and invasion of vulval introitus.

J.B.D.

Pregnancy and Labour Complicated by Ascending Myelitis and a Bedsore of Unusual Size

BY

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THIS case is reported because it must be of unusual occurrence and, therefore, possibly of general interest.

The patient was a multipara of 43 years of age, having had 4 children previously. Her pregnancies were normal except for the fourth during which she developed toxaemia of such severity that induction of labour at the 38th week was necessary. She was first seen on April 26th, 1940, after admission to hospital with unusual abdominal distension, abdominal pain, incontinence of urine and some oedema of feet and ankles. She was 18 weeks pregnant.

On examination the abdomen was found to be larger than usual for the duration of the pregnancy, being also hard, tense and painful. This condition was due to distension of the bladder with incontinent overflow. Slow emptying of the bladder relieved the abdominal signs and symptoms but the distension and incontinence recurred. Loss of power and sensation was noticed in the feet and the case appearing to be one of central nervous lesion it was transferred to the physicians.

Under the care of Dr. Smirk, the Professor of medicine, the patient's condition was declared to be one of rapidly ascending myelitis of obscure cause. The distribution of the elements of the spinal cord stopped at the level of the 4th dorsal vertebra, but below this there was complete loss of sensation and motor power. Nearly 4 months later the patient was returned to the obstetrical department for delivery. In the interval she had deteriorated and unfortunately had now a bedsore of quite unusual size and severity. Her temperature was normal, her pulse-rate 120, her respirations 30. The urine was free from albumin.

The pregnancy had now reached 35 weeks; the presentation was cephalic and foetal heart sounds audible. On inspection the bedsore extended from the lumbar region to the vulva. All tissues superficial to the sacrum, rectum and perineum had been destroyed, the rectum was exposed down to its muscular coat and the posterior commissure of the vulva reduced to an intact band of skin not more than 20 millimetres in width. Laterally the sore involved the buttocks and the gluteal muscles were exposed and pendulus in the edges of the sore.

More by good fortune than by judgment it was seen, at the same time, that the foetal head was so low in the vagina that the scalp was already showing at the vulva, completely painless labour having been in progress for some indefinite time. The birth of the child was completed in a few minutes without pain, the mother being unaware of the birth. The child was premature and small so that, fortunately, the narrow circumferential ring of vulval skin was undamaged. Uterine contractions of the 3rd stage were vigorous and the placenta was quickly expelled without any loss of blood. The child, a male, weighing 4 pounds 4 ounces, was alive and has since thrived. Immediately after the delivery the mother appeared to be in fair condition but an hour later she collapsed and died.

BOOK REVIEW

" Progesterone (Pregnandiol) and Oestrogen in Pregnancy."

A. M. HAIN, who previously (*Journ. Endocrinol.*, 1940, ii, 104), investigated the output of pregnandiol and of the two combined oestrogens in women approaching parturition and in one person throughout normal pregnancy, has now* examined the hormone output associated with abortion. The first part of her paper concerns five women in whom oestrogen and pregnandiol outputs were measured at very frequent intervals: four had had recurrent miscarriages and were treated with progesterone and (in the majority) vitamin E, etc., three going successfully to term. A normal pregnancy in a subject who had not aborted served as a control. In the first patient pregnandiol output was low throughout (10 to 14 mgm. during the first 4½ months, and subsequently a maximum of 40 mgm., i.e., below Venning's minimum for the same stage) but combined oestrone output was normal. The second woman, a sister of the first, had much higher pregnandiol excretion, and a very notable rise in output of the three oestrogens from the 211th to 224th days may have been related to acute emotional disturbance. The third patient aborted at 22 weeks, although her pregnandiol excretion had been sufficiently copious to exclude anxiety concerning the efficacy of treatment (vitamin E, 2 or 5 mgm. progesterone at three or two days' intervals, thyroid and calcium) given from the beginning of the fourth month. The remaining patient showed an extraordinary drop in pregnandiol output at about the sixth month and a lowered excretion throughout pregnancy. In the series neither labour nor abortion was associated with a rise of free oestrogen excretion; there was no clear evidence of cyclical variations in hormone output at monthly intervals; and rhythmic fluctuations in that output occurred towards term in the protracted pregnancies and suggested an extraneous form of control. Hain's second series consisted of over 100 patients in whom the pregnandiol output was measured at intervals of three or four weeks throughout pregnancy, and correlated in some cases with the results of Aschheim-Zondek tests. Cases of threatened abortion numbered 64; among these pregnandiol values were normal in 31, high in 8, and low in 25, i.e., satisfactory in 61 per cent and low in 39 per cent. (In 35 women of this series both pregnandiol analyses and Aschheim-Zondek tests were done. The Aschheim-Zondek test gave a standard or strongly positive result in two-thirds; and of the 15 cases terminating in abortion, imminent abortion—1 to 20 days—was only once associated with a weak Aschheim-Zondek finding: so that symptoms of threatened abortion would not appear to be attributable, even in a majority of patients, to low gonadotropin secretion). Abortion occurred both at low and high levels of pregnandiol excretion: 17 cases are recorded in which it followed within 1 to 14 days of a highly satisfactory pregnandiol titre. Hain inclines to the view that vitamin E deficiency may have been a contributory, if not a major factor in bringing about abortion: in 12 patients it was not given and in only one case could the dosage be regarded as adequate. Analysing the 14 cases in which abortion took place with a low level of pregnandiol excretion. Hain notes that pregnancy had usually been long maintained after the pregnandiol output had greatly diminished; taking this into consideration with the fact that amounts of progesterone which should have been adequate to maintain pregnancy often failed to prevent abortion, she regards it as a logical conclusion that " progesterone is not the main factor responsible for the maintenance of pregnancy, but that abortion occurs independently of the

* " Further Observations on the Role of Progesterone (Pregnandiol) and Oestrogen in Pregnancy." A. M. Hain. *Journ. of Endocrinol.*, Vol. iii, No. 1, March 1942.

amount of progesterone secreted and is due to a factor, or factors, which progesterone cannot inhibit." Concluding her discussion she writes, "Although it must be borne in mind that the mechanisms of abortion and parturition may be two different things, yet the bearing that these facts have on the causation of parturition is threefold:

(1) A high oestrogen level is of itself insufficient to set in train the events which precipitate labour, but may play a secondary part in the process.

(2) The values of pregnandiol and oestrogen excreted at the onset of labour (and abortion) are unimportant and may be high or low; there exists, apparently, a factor concerned with the control of their elimination and concentration in the body and it is this factor which is probably directly responsible for parturition. This control is cyclic and rhythmic in its effects.

(3) There is little doubt that the combined secretion of oestrogen and progesterone is essential for the maintenance of pregnancy, but their utilization may vary from individual to individual and at different stages of pregnancy; the peak in the output of both hormones which occurs during the last month of gestation may denote increased secretion or increased elimination or a change in utilization. It may, on the other hand, indicate that the pituitary responds differently to nervous stimulation at different stages of pregnancy, or that there is a change in the nature of its nervous control associated with parturition.

The time seems to have come when it is neither sufficient nor entirely true to say that parturition is due to a fall in the levels of oestrogen and progesterone and efforts might possibly be concentrated on controlling their secretion and excretion. In this way much might be learnt not only of the cause of parturition but also of the maintenance of pregnancy and the prevention of abortion.

The success attending progesterone or vitamin E therapy in cases of habitual and threatened abortion is, without doubt, largely dependent on the cause or causes underlying the condition. In the absence of any means for determining whether this is faulty utilization of progesterone, a deficiency of the hormone, vitamin E deficiency or an unspecified abortive factor, it would seem to be safest to combine progesterone and vitamin E therapy, of which the latter seems as successful as the former. Clinicians should be cautioned against interpreting a satisfactory pregnandiol output as an infallible indication of a satisfactory pregnancy, owing to the number of abortions taking place at such values, but be guided by the past obstetric history of the patient. The same applies to positive Aschheim-Zondek and Friedman findings."

W. E. CROWTHER.

Review of Current Literature

Director: FREDERICK ROQUES, M.A., M.D., M.Chir. (Cantab.), F.R.C.S., F.R.C.O.G.

THIS Review contains the lists of contents and abstracts of the more important articles from the journals with which the *Journal of Obstetrics and Gynaecology of the British Empire* exchanges.

The Review of Current Literature has kept the readers of the Journal in touch with current literature throughout the world; owing to the war many journals with which the *Journal of Obstetrics and Gynaecology* previously exchanged are no longer received. At the end of the year an Index of all the subjects contained in the articles of the journals reviewed is printed. Arrangements are also made to include abstracts of important articles on borderline subjects, such as Physiology, Biology, and Biochemistry.

LIST OF ABSTRACTORS

J. LYLE CAMERON, F.R.C.S.
W. E. CROWTHER, M.B.
R. H. B. ADAMSON, M.D.
B. JEAFFRESON, F.R.C.S.
P. MALPAS, F.R.C.S.
T. N. A. JEFFCOATE, F.R.C.S.
MEAVE KENNY, F.R.C.S.
JANE H. FILSHILL

The Lancet

January 17th, 1942.

*Neonatal thrush in a maternity hospital. G. B. Ludlam and J. L. Henderson.

February 7th, 1942.

*Peritoneoscopy. R. Milnes Walker and P. Lyon Playfair.

March 28th, 1942.

*Autodetoxication of stilboestrol during pregnancy. Bernard Zondek and Yehuda M. Bromberg.

May 23rd, 1942.

*Blood transfusion for obstetric haemorrhage and shock. H. L. Sheehan.

Future of obstetrics (Extract). J. M. Munro Kerr.

June 6th, 1942.

Psychology and childbirth (Extract). Ernest Jones.

NEONATAL THRUSH IN A MATERNITY HOSPITAL.

Ludlam and Henderson state that the high incidence of thrush in the nurseries of many maternity hospitals and its considerable mortality are not sufficiently appreciated. Thrush is a specific infection by *monilia albicans* and the authors have made an exhaustive enquiry into its incidence. They collected specimens from the mouth, hands and faeces of the infants and from the vaginae and nipples of the mothers. Specimens were also obtained from the throats and fingers of the nurses in attendance. In their series, 193 infants were swabbed and the fungus was obtained from 70 of them. They report that in 1940 the incidence of thrush was 6.4 per cent and in 1939 it was 7.2 per cent. In a group of 60 unselected infants, swabbings revealed the fungus in 11 cases; of these 8 had clinical thrush before they were 10 days old and the remaining 3 developed it after the tenth day. Thrush was never seen in an infant from whom a negative swab had been obtained. The high incidence of clinical thrush in this small series is due to the fact that very careful inspection was carried out whenever the swab was positive; such minute areas of thrush would probably have been missed in ordinary routine inspection. Premature babies showed a higher incidence of clinical thrush and of positive swabbings than full-time infants.

They stress the importance of not diagnosing a white area in the mouth as regurgitated milk curds

or furring of the tongue. Milk curds are not adherent and are easily rubbed off. Thrush should always be suspected when the tongue has a granular coating. The organism can easily be detected by microscopical examination of a fresh scraping teased in a drop of water.

Of the possible sources of infection, the authors specify the infants's mouth, faeces and hands, the nurse and the mother. From their experiments, there was no proof that air-borne infection was an important factor in the spread of thrush. Throat swabs of 60 nurses were examined and 20, or 33 per cent, gave a positive result. They consider that contamination of her hands from her mouth was most likely as these nurses wore masks while handling the infants. The higher incidence of thrush in bottle-fed infants could be accounted for by contamination of the feeding utensils. Apart from these considerations the authors are of the opinion that the high incidence of thrush is due to overcrowding in the nurseries and the failure to make an early diagnosis, with resulting delay in isolation and treatment.

PERITONEOSCOPY.

Many American authors are writing about the value of direct inspection of the peritoneal cavity through the peritoneoscope. In this paper, Walker and Playfair give an account of their experience. They describe in detail the points in the technique of the operation and how small the discomfort is to the patient. Although the organs of the upper abdomen can more clearly be seen they describe how they have been able to inspect the pelvic organs after the patient has been put into the Trendelenburg position. This examination is facilitated by an assistant's placing two fingers into the vagina and manipulating the uterus and appendages to enable their different surfaces to be seen.

In 16 cases the ovaries were examined, 8 on account of menstrual irregularities and 8 for ovarian cysts. Multiple unruptured Gräafian follicles and polycystic ovaries were recognized in the former group, and 3 cases of peritoneal metastases were seen in the latter group. Of 8 cases of carcinoma of the body or cervix of the uterus, three showed peritoneal malignant metastases, one hepatic metastases, and 4 evidence of broad ligament invasion.

The authors are of the opinion that, in a great variety of intra-abdominal and pelvic conditions, the method helps to settle points of differential diagnosis and that it might well be used more in Great Britain.

AUTODETOXICATION OF STILBOESTROL DURING PREGNANCY.

The synthetic substance, stilboestrol, when administered to the human female has all the effects of natural oestrone but certain toxic effects have been noted from time to time. These include nausea, vomiting, cutaneous and psychic reactions.

The authors describe how rapidly oestrogenic hormone disintegrates in the body; and that, in the rat, only one to two per cent of the hormone can be found in the body after a few hours. This inactivation takes place partly by combination with glycuronic acid but mostly by enzyme action in the liver. The hormone esters are much more slowly absorbed. On the other hand, stilboestrol is not inactivated by liver tissue to the same degree as oestrone, is absorbed slowly like the hormone esters, and the absorbed portion is not completely inactivated as 25 per cent of it can be recovered from the urine. This recoverable portion is much greater than the usual 1 to 2 per cent of the natural oestrone.

Stilboestrol, even when given in very small amounts, can give rise to toxic effects in man but the authors found that very large doses can be tolerated during pregnancy. They describe the histories of four cases to demonstrate this point. In three of them large doses were given to bring about an evacuation of the uterus for special indications and no intolerance was noted. In two of these cases a small dose was given a few hours later and marked toxic effects were apparent. The fourth case was given large doses of stilboestrol in the first week of the puerperium in order to check lactation and she tolerated this well. About eight weeks later a small dose was given and immediately toxic effects occurred. The authors maintain that these cases prove that a detoxication of stilboestrol takes place during pregnancy. They are investigating the means by which this comes about.

BLOOD TRANSFUSION FOR OBSTETRIC HAEMORRHAGE AND SHOCK.

As Sheehan points out, it is difficult to assess the value of blood transfusion in cases of haemor-

rhage and shock because of the difficulty of obtaining adequate control data; a surgeon cannot withhold transfusion from alternate cases in a large series of patients gravely ill from haemorrhage and shock. All that can be done is to compare the mortality from these two causes in a single hospital at a time when few or no transfusions were given with the mortality later when transfusions were being freely given.

From 1929 to 1940, 765 transfusions were given in the Glasgow Royal Maternity Hospital for haemorrhage and shock and 259 women died during parturition as a result of these conditions. The author is of the opinion that obstetric shock is fundamentally the same as shock in surgical trauma and that the value of blood-transfusion for this in obstetrics has a bearing on its value in general. During the first six years of this period few transfusions were given as compared with the second six-year period. During the last three years of this second period there was a decrease in the time taken to get the blood to the patient by the inauguration of a blood bank for the immediate transfusion of the desperately ill patients. During the second half of this twelve-year period there had also been a gradual improvement in obstetric technique, especially in the treatment of placenta praevia. Placenta praevia, abortion, post-partum haemorrhage, accidental haemorrhage, rupture of the uterus and inversion of the uterus were the chief obstetric complications which needed blood transfusion for the treatment of haemorrhage and shock. The patients who died were divided into four groups (*a*) haemorrhage, when the patient literally bled to death before the haemorrhage could be controlled, (*b*) haemorrhage-shock, when the bleeding was arrested but the patient died a few hours later with the symptoms of shock, (*c*) shock-haemorrhage, when there was only slight or moderate haemorrhage and the patient died essentially of shock, and (*d*) shock, when the patient died of shock uncomplicated by haemorrhage. The deaths from haemorrhage fell considerably during the twelve-year period, those from haemorrhage-shock fell moderately, but those from shock haemorrhage and from shock showed no appreciable change.

BRYAN JEAFFRESON

The British Medical Journal

April 4th, 1942.

*Puerperal cerebral thrombophlebitis. F. Ross Stansfield.

Puerperal cerebral venous thrombosis; report of a case. J. Joseph.

Primary thrombosis of cerebral veins in the puerperium; report of a case. D. R. Cairns and G. Malton.

April 11th, 1942.

Changes in haemoglobin concentration and plasma specific gravity following plasma transfusion. J. Beattie.

Changes in blood volume following transfusions of serum or plasma and the fate of the injected proteins. G. W. Hayward and A. Jordan.

April 26th, 1942.

*Review of the sanitary appliance with a discussion on intra-vaginal packs. Mary Barton.

May 2nd, 1942.

The problem of abdominal pain. Francis R. Brown.

May 9th, 1942.

*Massive blood-loss recovery. S. Way and F. Robertson.

May 16th, 1942.

*Inhibition of lactation by synthetic oestrogens. Josephine Barnes.

*Vitamin B_1 in the urine and placenta in toxaemia of pregnancy. H. C. W. Nixon, Margaret D. Wright and E. C. Fieller.

Hormonal control of lactation. Editorial.

May 30th, 1942.

Sublingual administration of methyl testosterone. A. W. Spence.

Full-time abdominal pregnancy with survival of mother and child. M. L. Slotover.

The androgens in clinical medicine. Editorial.

June 6th, 1942.

Pregnancy toxaemia and the posterior pituitary. Editorial.

June 13th, 1942.

*Diabetes mellitus and pregnancy. C. E. Woodrow.

*Paraldehyde in obstetrics. Douglas A. Mitchell.

Abdominal pregnancy: delivery of a living eight months' baby. Christia F. Lucas.

June 27th, 1942.

*The expanding pelvis. Kathleen Vaughan.

July 4th, 1942.

Obstructed labour due to conjoined twins. E. Ridehalgh.

*Megaloblastic anaemia of pregnancy and the puerperium. L. S. P. Davidson, L. J. Davis and James Innes.

*Further data concerning human fertility. F. Pugh Smith.

July 18th, 1942.

The incidence of breast-feeding in a small mining town. Enid. L. Hughes.

Nutrition of expectant and nursing mothers; report by Special Sub-committee of the People's League of Health.

PUERPERAL CEREBRAL THROMBOPHLEBITIS.

Cerebral thrombosis in the puerperium may not be primary since emboli may pass from the pelvic veins to the cerebrum by way of the vertebral plexuses. Rise in pressure in the inferior vena cava favours this. The onset of symptoms in recorded cases varies from 4 to 137 days after delivery. The initial headache, paraesthesiae and muscular weakness progress to definite paralysis. Death follows epileptiform convulsions and coma. There may be signs of increased intracranial pressure, and also of pyrexia. Of 14 cases quoted from the literature and 2 described here, 9 ended fatally. To prevent cerebral thrombosis, exercises, massage and heparin are suggested, increase in intra-abdominal pressure by binders and constipation should be avoided. In the presence of cerebral thrombosis, the treatment advised is heparin intravenously, lumbar puncture and intravenous hypertonic solutions to reduce intracranial pressure, and avertin or other anaesthetics to control the fits.

REVIEW OF THE SANITARY APPLIANCE WITH A DISCUSSION ON INTRA-VAGINAL PACKS.

Women patients between 14 and 50 years of age were questioned and it was found that 96 per cent still use an external appliance during menstruation. The reasons for this are ignorance of anatomy and fear that intra-vaginal packs may produce sterility or disease. The advantages of a tampon are that it allows freedom of movement, and avoids chafing and odour. Moreover it can be changed with a minimum of manipulation of the clothing.

The disadvantages are that virgins may find it difficult to insert and damage to the hymen may be inevitable. Cervicitis and vaginitis might result, but the writer has never seen a case. In discussing the question, the author suggests modification in shape, size and piston mechanism of the packs which manufacturers might adopt.

MASSIVE BLOOD LOSS; RECOVERY.

A 4-para, aged 24, was admitted at term with ante-partum haemorrhage. The patient was treated by artificial rupture of the membranes; but some hours later she suddenly collapsed. A diagnosis of ruptured uterus was made and a drip blood transfusion was continued for 4 hours. When laparotomy under local anaesthesia was performed, 8 pints of blood under pressure were found in the peritonial cavity, and the diagnosis was confirmed. Caesarean hysterectomy was carried out. Four hours later the abdomen was reopened for bleeding from the left uterine artery, and seven hours after that a further operation was required for oozing from the cervical stump. The patient had three abdominal operations within 15 hours and was transfused with 11 pints of blood and 1½ pints of plasma. She recovered but her blood group was changed from A to O by the massive transfusions; it returned to A by the twelfth day.

INHIBITION OF LACTATION BY SYNTHETIC OESTROGENS.

The theoretical basis of oestrogen therapy to suppress lactation is reviewed, as is the literature dealing with the use of oestradiol, oestrone, stilboestrol, testosterone proprionate and triphenylchlorethylene. In this investigation the values of dienoestrol and hexoestrol were tested and compared with that of stilboestrol. The best results are obtained if treatment is begun as soon as possible after delivery, and lactation is more easily suppressed after full-time pregnancies than after abortions.

In the doses used, stilboestrol gave the best results, but the dose of dienoestrol and hexoestrol

was varied for experimental purposes. Dienoestrol is effective by mouth in a dose ten times less than that required for hexoestrol and stilboestrol. The dose advised for dienoestrol is 2 to 3 mgm. over a period of 5 days, and for stilboestrol and hexoestrol 5 mgm. twice or three times daily for 2 days followed by gradual reduction over a period of 3 or 4 days. None of the preparations produce toxic effects in the puerperium, and there is little difference in their efficacy.

Diabetes Mellitus and Pregnancy.

In spite of modern treatment for diabetes, the mortality to the mother is still 5 per cent, and the foetal mortality is as high as 40 per cent. A case is described to illustrate the management (*a*) during pregnancy when sugar tolerance tends to vary, (*b*) during labour and the puerperium (*c*) of the child. Caesarean section at the thirty-sixth or thirty-seventh week is advised and the new-born child should be given dextrose to combat any tendency to hypoglycaemia in the first few days.

Vitamin B_1 in the Urine and Placenta in Toxaemia of Pregnancy.

Views on the relation between vitamin B_1 deficiency and toxaemia are discussed. Forty-six normal pregnancies and 60 toxaemic pregnancies were investigated. The vitamin was extracted from a 24-hour specimen of urine by absorption, and fed to vitamin B deficient rats. The only patients showing a significant fall in vitamin B_1 excretion were 9 suffering from eclampsia. Fifty-six placentae were examined and again only those obtained from eclamptics were deficient in vitamin B_1. In view of these findings and the similarity in the clinical features of eclampsia and beri-beri, it is suggested that vitamin B_1 may be useful in the treatment of eclampsia.

Paraldehyde in Obstetrics.

Rectal paraldehyde is valuable as an analgesic for primigravidae in labour. Six to 8 drachms in 5 to 6 ounces of olive oil is given when the cervix is 2 to 3 fingers dilated and can be preceded with advantage by omnopon and hyoscine. The disadvantage is that rectal administration gives too slow a result in the difficult patient. Therefore intramuscular injections of 10 c.c. of paraldehyde were tried and a good result was obtained. This can be supplemented with rectal paraldehyde when labour is prolonged. Paraldehyde is harmless to the patients suffering from toxaemia of pregnancy, so intramuscular injections were used in 10 consecutive cases of eclampsia. The effect was satisfactory, and all the patients recovered. The child born after the use of paraldehyde is sometimes lazy and sleepy for some hours, but suffers no permanent ill effect.

The Expanding Pelvis.

Radiographs of a girl of 14 illustrate the changes which occur in the pelvis on stooping. The pelvis is not a rigid structure but is capable of expansion at the symphysis in front and at the sacro-iliac joints behind. This flexibility, natural in the very young, can be maintained and developed by well-designed exercises even in elderly primigravidae, and can then be used in labour by the judicious use of posture. Perfect ease in parturition necessitates a trained control of muscular contraction and relaxation of the opposing muscles until the co-ordinated movements become instinctive.

Megaloblastic Anaemia of Pregnancy and the Puerperium.

Sixteen cases of megaloblastic anaemia were investigated. Only 2 were seen before delivery, but records of the pregnancies were available. The age incidence is lower than for Addison's pernicious anaemia, it occurs as frequently in primigravidae as in other parity groups. The number of red cells was below 1.7 million in 11 cases, and the colour index above 1.0 in 10.

Only 5 cases responded quickly to liver therapy, the refractory cases were given iron, yeast and ascorbic acid in addition. Blood transfusion, often repeated, was required in 12 cases in order to maintain life. Two patients died, the remainder made a complete recovery.

The outstanding features which often distinguish this condition from Addison's pernicious anaemia are the presence of free hydrochloric acid in the stomach, the lower frequency and the degree of macrocytosis and ovalocytosis. Sternal puncture, however, is essential to make the diagnosis. In every case, except one, examination of the bone marrow showed arrested maturation of megalo-

blasts. The name megaloblastic anaemia is, therefore, preferable to such terms as pernicious anaemia of pregnancy.

The aetiology of this disease is still disputed, but the most likely primary cause is a temporary failure of secretion of the intrinsic factor of Castle by the stomach during the later months of pregnancy. Other factors may be reduced intake of the extrinsic factor as a result of poor diet, anorexia and vomiting, impaired absorption from the intestine, and the demands of the foetus.

The condition is often refractory to liver therapy for a considerable time, but most patients ultimately respond and recover completely.

FURTHER DATA CONCERNING HUMAN FERTILITY.

Data are given showing the variation of 52 consecutive menstrual cycles in the same individual. Ovulation is assumed to occur 15 days before the onset of the next period. Records of uncontraceptive intercourse during 31 infertile cycles show that there were occasions when intercourse took place as much as 13 days before the beginning of the next period. Intercourse which took place on the 9th, 10th, 13th, 14th, 15th, and 16th days after the beginning of a cycle was followed by pregnancy.

Prediction of the narrower limits of the fertile period can only be made by counting back from the beginning of the next cycle.

T. N. A. JEFFCOATE

The Canadian Medical Association Journal

Vol. xlvi, January, 1942. No. 1.

*Nutrition in pregnancy. J. H. Ebbs, W. A. Scott, F. F. Tisdall, W. J. Moyle and M. Bell.

*The lower uterine segment: anatomical changes during pregnancy and labour. P. J. Kearns.

*The influence of improved prenatal nutrition upon the infant. J. H. Ebbs, A. Brown, F. F. Tisdall, W. J. Moyle and M. Bell.

NUTRITION IN PREGNANCY.

The maternal mortality rate in Canada has fallen from 5.7 to 4.0 per 1,000 live births in the years between 1926 and 1940. The neonatal mortality rate in 1940 was 39 per 1,000 live births, and this was roughly half of the total infant mortality rate. Much progress has been made in reducing the infant mortality rate, but very little in reducing the neo-natal death rate. Study has been made of 229 consecutive deaths in babies occurring before delivery, or during delivery or during the first 2 weeks of life. Prematurity was the cause of 49 deaths; foetal deformity held next place in being the cause of 37 neonatal deaths. The ordinary accidents of labour and chronic illness of the mother accounted for the remainder.

It is the purpose of this paper to discuss the influence of poor, improved, or good prenatal diet, on the course of pregnancy. During pregnancy the daily requirements are total calories, 2,400 to 2,800; protein, 80 to 100 grams; fat, 80 to 100 grams; carbohydrates, 350 to 400 grams; calcium, 1.5; iron, .020; iodine in iodised salt. Vitamins required are A, 6,000 i.u.; B_1, 500 to 1,000, i.u.; B_2, 3 to 3.5 mgm.; C, 50 to 75 mgm.; D, 500 to 1000 i.u. Expressed as a dietary this would be a daily requirement of 40 ounces of milk, 1 ounce of cheese, 1 egg, butter and meat daily, liver once a week, a liberal supply of vegetables besides potatoes, one orange or grapefruit, or 5 ounces of tomato juice. Cereals or bread should be given as wholemeal to at least 50 per cent of its amount; cod liver oil or its equivalent should be given to the amount of two teaspoonsful.

It is found, especially among the poorer classes with low incomes, that the diet falls far below this standard. Frequently this is due to ignorance of the amounts of the different foods which should be taken, or to long established habits. In cases of persistent vomiting the food intake is often far below requirements.

Prenatal care is now provided by clinics and private physicians for a large proportion of expectant mothers and it is considered desirable that a part time dietitian should be provided to give practical instruction regarding the essentials of nutrition and to help the physician in planning a suitable diet.

A study is made of 400 women attending a prenatal clinic. A record has been kept of every article consumed by the patient each day for a week. This record was then analyzed and the patient concerned placed in one of three groups for observation. In group 1, with poor diet, there were 120 patients half the patients were left on low diet

as controls. In the second group 90 patients were given extra foods. In the third group were 170 women who had an income sufficient to provide an adequate diet, and who were given advice; this was regarded as a good diet group. There were therefore three groups, on poor, supplemented and good diet respectively, and some interesting tables are presented.

Pre-eclampsia occurred in 12.6 poor diet patients; 9.1 in the supplemented group and 7.8 in the good diet group. Threatened miscarriage occurred respectively in the proportions of 11.2, 8.3 and 4.7 per cent; accidental haemorrhage in 3.2, 4.7 and 0 per cent; severe vomiting in 3.4, 1.4 and 1.2 per cent; pyelitis in 5.0, 3.4 and 4.2 per cent; streptococcal vaginitis in 1.7, 0, 0 per cent. Freedom from complications were recorded as 30.3. 45.9, and 48.5 per cent respectively in these three groups.

Major complications occurred during labour in these three groups as follows: miscarriages, 6.0, 0 and 1.2 per cent; premature birth, 8.0, 2.2 and 3.0 per cent; stillbirth, 3.4, 0 and 0.6 per cent; primary uterine inertia, 6.0, 0, 3.5 per cent; secondary uterine inertia, 3.5, 1.1 and 4.2 per cent; Necessity for blood transfusion, 2.6, 0, and 0.6 per cent.

Figures proportionately comparable were obtained when special conditions were considered, such as the average duration of labour, the condition of the mother during convalesence, and complications affecting the mother while in hospital. One table is interesting. It gives the average birth weight of the babies, that for poor diet is 7 pounds 10 ounces; supplemented diet 7 pounds 7 ounces; and good diet 7 pounds 6 ounces; showing that diet appears to have little or no effect on the weight of the baby. The general condition of the patients 6 weeks after delivery was shown to be poor in the group with low diet, better with the supplemented diet, and good with adequate diet.

Briefly summarized the results of the investigation have shown that there is a much higher incidence of miscarriage, stillbirth, premature birth and other complications in all cases on a poor diet, and the whole course of pregnancy appeared to be influenced by supplying an adequate diet when this was already deficient. Numerous highly explanatory tables are included, and a brief bibliography is appended, together with an excellent résumé in French by Jean Saucier.

THE INFLUENCE OF IMPROVED PRENATAL NUTRITION UPON THE INFANT.

The infant mortality rate in Toronto was reduced by 40 per cent in the years between 1929 and 1939. The decrease in the death rate was 7 per cent for babies under one month, and 37 per cent for infants between one month and one year of age. The same figures held true for the whole of Canada, the infant mortality rate of which in 1937 held sixteenth place in a list of 40 countries. An attempt has been made in this paper to show that the neonatal death rate may be lowered by the provision of a suitable prenatal diet for the mothers.

Three groups of patients were studied from among those attending a prenatal clinic (a) a group of 120 women on poor diet; (b) a group of 90 women with supplemented diet, and (c) a group of 170 women on good and regulated diet.

The supplemented diet consisted of 30 ounces of milk, 1 egg, and 1 orange daily, together with 3½ ounces of canned tomatoes and 1 ounce of cheese. Patients also received a viosterol capsule containing 2,000 units of Vitamin D per day, and 2 tablespoonsful of wheat germ per day. This diet was introduced between the fourth and fifth months of pregnancy and continued for 4 weeks after the patient left hospital. The conditions of the mothers were rated either good or bad in the following percentages; those on poor diet, good 66, poor 34; those on supplemented diet, good 94, poor 6; those on good diet, good 85, poor 15. It was also found that the women on poor diet suffered more complications of pregnancy. Anaemia occurred in the following percentages: patients on poor diet, 28.6; supplemented diet, 16.1; good diet, 21.6. Pre-eclampsia and eclampsia, poor diet, 12.6; supplemented diet, 6.1; and good diet, 7.8. Threatened abortion, poor diet, 11.2; supplemented diet, 8.3; and good diet 4.7. Miscarriage (in percentages among the three groups as before) 6.0, 0, 1.2; stillbirth, 3.4, 0, 0.6; primary uterine inertia, 6.0, 0, 3.5; premature birth, 8.0, 2.2, 3; pelvic inflammation during convalescence, 9.0, 3.4, 6.1; breast inflammation, 4.5, 2.3, 4.8.

An attempt was made to follow up the babies born to these groups; examinations being made at

intervals of 6 months. The average birth weight of the babies born to the mothers in the poor-diet group was slightly higher than in either of the two other groups, but at 6 months the weight of the babies was greater in those born to the mothers in the supplemented and good diet groups. The ability of the mothers to nurse the babies occurred in the following percentages. In the poor-diet group, 42; supplemented, 52; good diet, 49. Breast feeding was regarded as good, fair, or poor according to the capacity of the mother to nourish the child. Poor feeding was noted in the following percentages. Poor diet, 17; supplemented, 6; good diet, 8. When all was considered babies of the poor-diet group did not do so well as those on supplemented diet and good diet.

In conclusion it is considered that the percentages of successful pregnancies among poor women was increased by supplying simple foods, and the effect upon infant mortality and morbidity was marked.

A short bibliography and reference to previous publications is appended together with a short résumé in French by Jean Saucier.

THE LOWER UTERINE SEGMENT: ANATOMICAL CHANGES DURING PREGNANCY AND LABOUR.

It was noted by the author on the examination of pathological specimens in the gynaecological and obstetrical museum that there was a relatively high frequency of damage to the lower uterine segment during labour. A study was made in an attempt to correlate the anatomical changes in the lower segment with the incidence of traumatic defects in this region.

Many attempts have been made to delimit the lower uterine segment, anatomically, histologically and physiologically, but all are at variance. However, it is roughly estimated that the uterus is divided into corpus, isthmus and cervix. The isthmus is approximately 0.5 cm. in length, in the non-pregnant uterus, but it is greatly increased in length as the uterus enlarges in hormonal hyperplasia of the myometrium and in the physiological enlargement of early pregnancy.

A lower corpus sphincter is seen in the uteri of almost all mammals or in those developing a corpus luteum; but in those which develop segmental pregnancies, such as the pig this sphincter occurs in the caudal zone of each segment or chamber. This caudal sphincter in the human female develops about the fourth month of intrauterine life and grows with the uterus. In the full-time foetus it is fully developed and stands in contrast to the small corpus uteri. The isthmus appears to have the same blood-supply as the body of the uterus in the non-pregnant state, but during the first months of pregnancy many new branches arise from the uterine artery, giving the lower segment a rich blood supply. The nerve supply of the lower uterine segment remains rather indeterminate. The relative control by the sympathetic and parasympathetic nerves is still disputed by many authorities.

During pregnancy, the isthmic part of the lower uterine segment becomes part of the ovum chamber about the fourth month of gestation, the mucosa not being truly decidualised. Gradually the whole of the isthmus, together with the upper part of the cervix, becomes a part of the ovum chamber, until at term only the lower third of the cervical canal and external os remain to be dilated during the first stage of labour. In malpositions of the foetus however, some of the cervix remains to be dilated, thereby causing prolonged labour. During delivery the external os and the remaining portion of the cervix become inextinguishably incorporated in the ovum chamber. The chief function of the internal uterine sphincter in the non-pregnant uterus appears to be the separation of the cervical canal from the corpus uteri, thereby separating infections of the cervical canal from the uterine cavity, and it appears to prevent the ovum from falling into and becoming implanted in the cervical canal. It acts as the internal sphincter of the uterus until the third month of pregnancy, when it begins to relax. Late in pregnancy it prevents the ovum chamber from becoming over dilated in its lower part and during labour it prevents over distension and possible rupture of the weak isthmic region.

Abnormal function in the lower uterine segment may be due to some aberration of the nerve supply whereby relaxation is replaced by over constriction of the internal sphincter forming what is known as a constriction ring. This ring may be present below the presenting part or may grasp some portion of the foetus. When there is some obstruction to labour, the muscle of the corpus

uteri may become tonically retracted, producing a Bandl's ring, which is drawn high upwards and a new thinned out portion of the uterus develops above the isthmus. This new pathologically-formed segment is much more friable than the physiological lower segment and it is here that rupture usually takes place. Once started these tears may extend far downwards and may result in laceration of the uterine artery or some of its branches.

From the author's findings he has concluded that a more effectual way of expressing the placenta is to grasp the lower uterine segment and to pull the fundus away from the placenta, instead of pressing the fundus downwards, thereby flattening the lower uterine segment; in the same way firmly packing and distending the lower uterine segment to control uterine haemorrhage will not only produce shock, but will tend further to cause dilatation and increase of the haemorrhage.

Eight excellent specimen illustrations are included in the text.

J. Lyle Cameron

Medical Journal of Australia

November 15th, 1941.

*Endocrine causes of disorders of menstruation and bleeding from the non-gravid uterus. S. Devenish Meares.

November 22nd, 1941.

*Special article. Public relations of medical practice. History of events in New Zealand, 1941. Maternity benefits.

December 6th, 1941.

Pregnancy complicated by a double uterus. Report of two cases. G. Shedden Adam.

Absence of the vagina successfully treated without operation. Kate Campbell.

December 13th, 1941.

*Brenner tumours of the ovary, with report of a case. J. D. Hicks.

Erythroblastosis and transfusion accidents in pregnancy.

Endocrine Causes of Disorders of Menstruation and Bleeding from the Non-gravid Uterus.

Meares gives a short résumé of the activity of the endocrine system as it affects the endometrium. He considers that all endocrine treatment should be preceded by accurate physiological diagnosis. He discusses disturbances of sex hormone equilibrium under the following six headings.

1. Menorrhagia and allied uterine bleeding. (a) ovular, (b) anovular, (c) from unproliferated endometrium at puberty or after the menopause, (d) anovular pseudomenstruation.
2. Amenorrhoea.
3. The effects on menstruation of disorders of other endocrine glands (a) thyroid, (b) suprarenals, (c) pituitary.
4. Granulosa-cell tumours.
5. Hydatidiform mole and chorion-epithelioma.
6. Dysmenorrhoea.

As regards sex hormone treatment in general he stresses that correct therapy depends upon accurate diagnosis including a proper knowledge of the nature of the deficiency. Haphazard and unscientific treatment with indiscriminate administration of hormones will not prove other than disappointing and may do considerable harm. Sex hormones however administered do not act instantaneously. Even with rapid absorption there is a latent period of 24 to 48 hours. The most harmful effect of oestrogenic therapy is depression of the anterior pituitary function and, so, of ovarian activity. For this reason treatment by oestrogens should never be prolonged more than a few months and is preferably not given continuously to minimise the risk.

He recommends the avoidance of all male hormones. Gonadotropic therapy is not regarded with favour. There is no proof that gonadotropic hormone is followed by a complete ovarian response.

Public Relations of Medical Practice. History of Events in New Zealand, 1941 Maternity Benefits.

There is a special article reviewing the course of events as they affected medical services in New

Zealand since 1935. In 1935 the National party held a departmental committee to consider national health plans.

In November, 1935, there was a general election and a Labour Government was returned. Early in 1936 representatives of the British Medical Association waited on the new Minister of Health offering co-operation and asking for his confidence. This request was not acceded to and the Association was kept entirely in the dark until the last minute.

In 1936 the Government set up a committee consisting wholly of members of Parliament of the government party. The only medical member was a junior practitioner who had just been elected. The British Medical Association gave evidence before this committee and later Sir Henry Brackenbury went out to New Zealand to render service both to the Government and the Association. In 1938 the Social Security Bill was presented to the House; only after this was it submitted to the Association. The Bill became law shortly afterwards.

The Social Security Act, 1938, had two main objects. The first was a system of monetary benefits on a contributary basis and also a system of medical, hospital and related benefits. The money was to come from a new tax of one shilling in the pound payable by practically the whole community and to replace the previous unemployment tax of eightpence in the pound payable by a smaller circle. The medical benefits were to make general practitioners' service available to every person in the community. Maternity benefits were limited to such services as a general practitioner would ordinarily give.

With the next general election matters became very heated and the Bill was used freely in an endeavour to discredit the Labour party. It was, however, returned to parliament with an absolute majority.

In March, 1939, the Minister of Health circularised the medical practitioners in an endeavour to obtain their co-operation but in the end the medical benefit question was dropped for the time being until 1941.

In April, 1939, it was announced that a beginning would be made with maternity benefits and an offer of contract with the Government was submitted to all practitioners. This contract was signed by only 22 practitioners, because conditions were considered to be too irksome both to patients and practitioners; in addition there was no provision for consultant's help. There was then prolonged negotiations between the Government and the British Medical Association for several months; in the end an agreement was reached. This came into effect in November, 1939, and essentially dispensed with any contract of service but allowed the practitioner to fill in a form and for each case of delivery or miscarriage he attended, submit this to the local medical officer of health and receive payment out of the Social Security Fund. The usual fee for a confinement is £5 and for a miscarriage £3. In addition there are other fees for abnormal cases on a fixed scale. Obstetric specialists under the scheme must be recognized as such by the minister, according to standards of academic qualification and mode of practice as laid down by the Health Department. Such a specialist may charge a fee in excess of those laid down under social security, but no other doctor may do so. The general practitioners appear to be fairly well satisfied with the scheme for though the fees are not high there is a certainty of being paid.

Brenner Tumours of the Ovary with Report of a Case.

J. D. Hicks refers to the 122 recorded cases of Brenner's tumour of the ovary of which the first was observed in 1907.

He discusses various theories of its origin and is personally in favour of the view put forward by Meyer that Brenner's tumour is closely related to a large group of serous, pseudomucinous, papillary, adenofibromatous and mixed tumours of the ovary and arises directly from the Walthard inclusions, which are themselves derived from the pluripotent coelomic epithelium. Clinically they are benign and they tend to occur in elderly patients. There is some resemblance to squamous cell carcinoma in some areas and the question of the complete disappearance of the epithelial elements of the tumour is raised.

R. H. B. Adamson.

American Journal of Obstetrics and Gynecology

Vol. xli, No. 3.

Some remarks about maternal mortality in the south. J. R. McCord.

*The theca cone and its tropism toward the ovarian surface, a typical feature of growing human and mammalian follicles. E. O. Strassmann.

Deep cauterization of the cervix. B. Z. Cashman and J. S. Frank.

THE THECA CONE AND ITS TROPISM TOWARDS THE OVARIAN SURFACE, A TYPICAL FEATURE OF GROWING HUMAN AND MAMMALIAN FOLLICLES.

This article is most interesting and stimulating. It has added to our store of knowledge with regard to certain processes in the ovary which have baffled explanation up to the present time. Strassmann describes the four theories, which have been in vogue from time to time, concerning the processes leading up to and including ovulation. The first was that of Pflueger, who believed that peristalsis of the ovary was the cause of ovulation this was soon proved to be incorrect as no plain muscle, other than that of the blood-vessels, has ever been demonstrated in that organ. The second theory of ovulation regarded active or passive hyperaemia as the actual cause; this was the result of the current belief that menstruation and ovulation occurred at the same time. A third theory was that enzymes digested the lining of the follicle. The fourth and most popular idea was that ovulation was brought about by an increased pressure within the follicle. The author himself has no doubt that the intra-follicular pressure plays a role in the final rupture of the follicle, but in this paper he establishes the sequence of events which lead to this final stage. The chief question which has to be answered is how do the follicles manage to return to the surface of the ovary.

To elucidate this problem, Strassmann has studied over 18,000 serial sections of ovaries of man, dog, cat, rabbit, horse, cow, and swine over a period of 18 years. He explains the descent of the small follicles into the medulla of the ovary as a passive one, as the cortex offers more resistance to their growth than the stroma; the second movement, the ascent of the large follicles to the surface, as an active one which takes place against the resistance of the cortex. The first step he noticed was that there was an eccentric growth of the theca interna towards the ovarian surface, which showed as a one-sided thickness of the theca interna at the upper hemisphere of the follicle. Where the follicles were near the surface, the theca interna at the upper hemisphere was eight to 10 times thicker than at the lower pole. The fibrous theca externa was noticed to be much thicker at the lower pole than at the pole near the surface. So the rapidly-growing theca interna cells at the upper pole had much less resistance of fibrous theca externa to overcome and could more easily expand towards the surface of the ovary. This eccentric growth verified in all the mammalian orders examined as well as in the woman and the author calls it the " theca interna cone." The author maintains that this cone-like growth is an active one towards the surface of the ovary and ploughs a path for the expanding follicle. He also demonstrates a protrusion of a cone of granulosa cells into the theca interna cone so that the axis of the one coincides with the axis of the other. In all the mammals except the horse he found that the theca interna cones grow divergently towards the nearest point of the ovarian surface. In the horse the ovary is covered with mesovarium except for one little spot, the ovulatory fossa, from which ovulation takes place. He found that in this animal the theca cones always pointed towards the ovulatory fossa, thus proving that the theca cone had the special function of bringing the follicle up to that part of the ovarian surface where the ovum can enter the peritoneal cavity. He gives his opinion why this theca cone has been missed in an organ which has been thoroughly investigated for many generations. He says that the cone can most easily be recognized when a vertical section has been made through the follicle and that it cannot be seen if, by chance, the section was horizontal. He suggests, too, that the recognition of this cone might be used as a more sensitive test of the presence of gonadotropic hormones as the usual ovulation with haemorrhage is a test which needs an overdose of hormone.

BRYAN JEAFFRESON

REPORTS OF SOCIETIES

ROYAL ACADEMY OF MEDICINE IN IRELAND.

A meeting of the Section of Obstetrics of the Royal Academy of Medicine in Ireland, was held in the Royal College of Physicians, on Friday, March 20th, 1942. The President, Dr. NINIAN FALKINER, was in the chair.

Dr. BETHEL SOLOMONS read a paper dealing with SEVEN HUNDRED AND NINETY CASES OF ABDOMINAL HYSTERECTOMY.

He showed a coloured film of total hysterectomy. Both the total and the subtotal operations are performed. The indications are given; there are few indications for the vaginal route. It is far more important that the gynaecologist should know when a hysterectomy is indicated, than that he should know which variety to do. Both points are important, but there are too many unnecessary hysterectomies. Hysterectomy is seldom indicated for such conditions as osteo-arthritis or psychopathic disturbances, but a few examples are described. From answers to the questionnaire it seems of little importance whether the ovaries are conserved, or not. The technique of the author was described in *Surgery, Gynaecology and Obstetrics*, in October, 1940. Team work is essential. Methods for the avoidance of pulmonary embolism are suggested. The results of the questionnaire are given. There were 17 deaths in 790 operations; this gives a mortality rate of 2.16 per cent. In at least four of the deaths hysterectomy had been done for extra-uterine conditions, so the corrected mortality rate is 13, or 1.6 per cent. The details of the deaths are stated. There have been no fatalities from hysterectomy in the practice of the author since 1937. In uncomplicated cases the mortality for hysterectomy should be infinitesimal with improved technique.

Whilst spinal anaesthesia gave wonderful relaxation he thought general anaesthesia was safer, especially in Dublin where the anaesthetists were so capable. He insisted on team work; and success could not be achieved without a good assistant, and skilled nursing both in the operating theatre and in the convalescent period.

The unskilled operator should not attempt either the total or the subtotal operation.

He could not say anything about those patients who had not answered the questionnaire. Only 12 patients in the series complained of urinary symptoms. As a general rule he left a small wick of gauze outside the peritoneum which was brought through the vagina when the total operation was done.

The PRESIDENT, in thanking Dr. SOLOMONS for his paper, said that those present were very fortunate in having had an opportunity of hearing this review of cases of abdominal hysterectomy, and of seeing the colour film which had demonstrated Dr. Solomons's technique so very well. He asked if this series of cases included cases of hysterectomy which had been done for carcinoma of the cervix. The low incidence of malignant disease in Dr. Solomonses's cases was remarkable, as was also the fact that there were 12 tuberculous cases. He asked how Dr. Solomons interpreted the septic condition of the blood in these cases with regard to the likelihood of thrombosis developing.

PROFESSOR A. H. DAVIDSON said that this was a very important and instructive communication, and the film was an excellent one. He had been very interested in such films for some time and was the first person to show a film at the Obstetrical Section. This film showed Dr. Solomons's technique very beautifully. His technique was very good, and no criticism could possibly be made of it. It was possible from the film to follow the operation from beginning to end. He asked if Dr. Solomons left a drain in the pelvis after total hysterectomy, or if he closed the vagina altogether.

Unless there was definite sepsis in the abdomen he did not think that there was any necessity to leave either a plug of gauze or a drain in. Dr. Solomons was to be very highly congratulated on such a wonderful series of cases. To be able to say that in this large series of cases his mortality rate was 2.16 per cent, and that, corrected, it was something less than this, was certainly good. He was strongly of opinion however that it was quite wrong for Dr. Solomons to be allowed to get away with the fact that in 798 cases he had not found one single case in which vaginal hysterectomy was indicated. This he thought must surely be a mis-statement. He would like to contradict it strongly. In his opinion vaginal hysterectomy had a place in obstetrics, and a very definite place. American workers were now coming round to the fact that they preferred vaginal hysterectomy to abdominal hysterectomy in cases in which it could be done, and it could be done fairly often. It was an operation which was practically free from the complication of pulmonary embolism and pleural thrombosis. He thought the reason for this was that the patients were able to move about from the very beginning. Referring to the fact that Dr. Solomons had stated that it did not matter whether the ovaries were conserved or not, apart from the psychological effect on the patient, he said that some years ago he had investigated this point. He had found that the menopause occurred earlier, perhaps more severely, in women whose ovaries had been removed. In the last year and a half he had seen four women in hospital who had come back following abdominal hysterectomy complaining of severe pain in the pelvis. In these cases there was cystic degeneration of the ovaries which had been left behind. Quite often when the ovaries were left behind they became cystic. He was inclined not to leave the ovaries at all, especially in women over the age of 40 years.

A number of American authorities had recently shown that the incidence of carcinoma of the cervix in cases of retained cervical stump was two or three per cent. He had not done a subtotal hysterectomy for five or six years because he believed that if the cervix was left behind it was very liable to give trouble. His opinion was that total hysterectomy was the operation which should be done, and that vaginal hysterectomy should be done as often as possible.

Dr. J. F. CUNNINGHAM said that there was a very big place for vaginal hysterectomy, but the cases should be carefully selected. Hysterectomy should in his opinion be done in the way which caused the least danger to the patient. The abdominal route was preferable in the presence of tumours, but in other cases the vaginal route should be chosen. Following this operation the patient could move about in bed much more easily, and could be allowed to get up earlier. He asked Dr. Solomons why he did the subtotal operation so frequently. The complications following this operation were more numerous than those following total hysterectomy. He never closed the vagina. Why did Dr. Solomons use the ring which he had shown? Was it to prevent irritation of the skin? This would not occur if dettol was used, but it would occur if iodine was used. Why was the spade retractor used if a good anaesthetic was given? Very often there was a certain amount of strain during the operation, and this spade retractor would not, he thought, prevent the intestines from coming down on each side. Even in cases of infection he thought that silk gave a better result than catgut. There was less infection associated with it. He himself always used linen thread. He was interested to see that Dr. Solomons used one clamp only; he always used several.

Dr. R. M. CORBET said that in doing abdominal hysterectomy he used the technique which he had been taught by Dr. Solomons. The spade retractor was of the greatest possible use. It made the operation much easier for the anaesthetist. He would like to support Professor Davidson's plea for vaginal hysterectomy. It was possible to do this operation under local anaesthesia. American obstetricians were very ready to do vaginal hysterectomy, but seemed to be very reluctant to do the total operation. This fact might perhaps account for the relavent prevalence of cervical carcinoma in America. In Ireland the incidence of cervical carcinoma and of stump carcinoma was lower than it was in the U.S.A. He preferred the total to the subtotal operation, but he did not always feel that he could do it to the best advantage of the patient. On the whole he had had more trouble following the subtotal than the total operation.

Dr. J. S. QUIN said that the film was excellent and demonstrated very well the technique used by Dr. Solomons. He referred to a paper he had recently read on carcinoma of the stump of the cervix following subtotal hysterectomy. In this paper the conclusion reached was that subtotal hysterectomy was never justified. The trouble in most of these cases started six months after the operation. This fact showed that the cervix had not been examined so carefully as it should have been during the operation. There was a considerable amount of bladder irritability following hysterectomy. This irritability was, he thought, probably greater after the total than after the subtotal operation. He considered that Dr. Solomons had held the mean between the two operations judiciously, but he was of opinion that Dr. Solomons had put vaginal hysterectomy into a more junior place in the surgical aramentarium than it actually deserved. For a considerable time he had been looking for a case of sciatica caused by a fibroid, and he had never found one. He was doing more and more hysterectomies, total and subtotal, under spinal anaesthesia and morphia, and by this means he had avoided much pulmonary trouble.

Dr. J. G. GALLAGHER suggested that perhaps some of the hysterectomies done by Dr. Solomons had been unnecessary. Only 14 operations had been done for malignant disease of the body of the uterus. This fact would tend to point out that most of the operations had been done for relatively simple conditions. About 40 per cent of patients had not replied to the questionnaire which Dr. Solomons had sent out. The reason for this might perhaps have been that they were dissatisfied with the operation. If Dr. Solomons came across a patient with a large cystocele and a rectocele, what did he do? Such cases were he though suitable for vaginal hysterectomy. Carcinoma of the cervix was a relatively rare condition in Ireland, and he did not think that it should be considered in connexion with Dr. Solomons's paper.

Dr. P. FITZGERALD gave some technical advice about the film, and suggested that Dr. Solomons should use finer silk for sewing up after the operation than he was using at present.

The Master of the National Maternity Hospital said that he had never had an opportunity of using the spade retractor shown by Dr. Solomons. Until about two years ago he had always used packs, and then he had given them up. Now he very seldom had to use one at all; he thought it was an advantage not to use packs. It was his custom not to remove the ovaries if he could avoid doing so. There were times however when it was absolutely necessary to remove them. In the cases in which he had removed them a considerable number of the women had suffered from very severe menopausal symptoms. He would never remove the ovaries unless there were clear indications for doing so.

Dr. A. P. BARRY said that he would never perform total hysterectomy unless it was absolutely indicated, as it was an operation which led to the occurrence of bladder symptoms afterwards.

Dr. BETHEL SOLOMONS, in reply, said that cases of cervical carcinoma were not included. He believed that tuberculosis of the uterus was more common than was realized, and the laboratory reported 12 in the series; in some of these hysterectomy had been performed for tuberculosis of the Fallopian tubes. If an operation could be deferred until the sedimentation rate was slow infection was less likely and thrombosis less probable. He pointed out that the title of his paper was "Abdominal Hysterectomy." He had done vaginal hysterectomy but it should be reserved for those cases in which vaginal repair was necessary in addition to the removal of the uterus. He found with his technique that there was less shock after the abdominal operation, and he preferred that route to the vaginal. In the series there were 352 subtotal operations, and 438 total.

In recent years he had been more inclined to perform the total operation, but there was no danger of malignant disease in the stump after the subtotal operation if great care were taken in the selection of cases in which the cervix was absolutely clean. If the ovaries were cystic he removed them. He found it easier to work when the clamps were removed and suturing done before the uterus was taken away. Silk was preferable to catgut unless infection was present; he used fine silk. There were only two cases in the series in which intractable sciatica had been cured by the removal of large tumours.

Dr. J. F. CUNNINGHAM, PROFESSOR J. MCGRATH, and Dr. D. K. O'DONOVAN read a paper on

POSTPARTUM PITUITARY NECROSIS, ILLUSTRATED BY GRAPHS SHOWN ON THE SCREEN.

Details of the obstetrical histories of three cases of postpartum pituitary necrosis are presented. These cases represent the varying degrees of severity with which the disease may manifest itself. One patient died soon after parturition, a second survived in a condition of chronic invalidism, while a third was in relatively good general health 18 months after the onset. The post-mortem on the fatal case showed a large area of necrosis in the anterior lobe of the pituitary.

The necessity for immediate recognition and treatment during the first week is stressed. Large amounts of carbohydrate given by every possible route are essential in the acute phase when complicated by hypoglycaemia. The diagnostic value of the response to small subcutaneous doses of insulin is exemplified. The intravenous insulin test of Russell and Fraser (1941) as a diagnostic procedure is confirmed. Using these insulin sensitivity tests the value of desoxycorticosterone, cortin and pituitary adrenocorticotrophin as substitution therapy was assessed. None of these hormones established a normal insulin sensitivity. The adrenocorticotrophin (cortrophin of Organon Ltd.) caused a significant increase of body weight, alleviated the myasthenia and anorexia. It is therefore considered a useful, but incomplete, source of substitution therapy.

The various hormonal deficiencies which constitute Simmond's disease are outlined and it is assumed that the human pituitary secretes a hormone which directly influences metabolism, besides the indirect effects mediated through the adrenal cortex and thyroid.

Professor W. J. JESSOP, in thanking the authors for this extremely interesting and instructive paper said that he would like to pay a special tribute of admiration to Dr. O'Donovan for the magnificent analysis which he had given demonstrating the way in which the deficiency of the various hormones was responsible for various symptoms. He referred to the sensitivity of patients and said that it was really necessary to know how much anterior pituitary a person needed. At the present time in England some surgeons were trying to cure Cushing's disease by putting radon seeds into the neighbourhood of the sella turcica.

PROFESSOR BIGGART referred to three cases of acute necrosis which had proved fatal, and three cases of Simmond's disease which had been proved at post-mortem examination. In the rat 33⅓ per cent was sufficient to retain metabolism as regards the pituitary. In an examination of 2,000 pituitaries which he had carried out he had found only three cases of necrosis. It would be of great interest to know exactly how these cases were produced. It was possible that the retention of the placenta might play a more important part than shock. An attempt should be made to see if there was an increase in the circulating hormones of placental origin. The only other condition in which necrosis was found was cavernous sinus thrombosis.

Dr. P. FITZGERALD said that the peculiarities of the anterior pituitary were well known. These peculiarities were not present in the posterior lobe, but were confined to the anterior. He asked Dr. O'Donovan if any sign of thrombosis had extended into the hypothalmic region in the present cases.

Dr. CUNNINGHAM and PROFESSOR MCGRATH replied, and the meeting concluded.

ISIS holding a Figure of Osiris between her wings

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